ENERGY USE ENGINEERING DEPARTMENT

PROJECT 8109

HIGH EFFICIENCY GAS FURNACE FIELD TESTS
INTERIM REPORT
1983

ENERGY CONSERVATION DIVISION

B.C. HYDRO AND POWER AUTHORITY

ENERGY USE SERVICES

The Energy Use Engineering Department provides engineering, technical and marketing impact advice on energy use with emphasis on energy management, prudent energy usage, efficient applications and energy conservation.

The service is provided by a team of four sections supervised as follows:

*HEATING, AIR CONDITIONING, VENTILATION & REFRIGERATION	Dr. Z. El-Ramly, P.Eng.	(663-3277)
*ELECTRICAL & LIGHTING (including associated wiring, electronics, and codes)	R.F. Hughes, P.Eng.	(663-3280)
*RESIDENTIAL APPLICATIONS (including associated appliances, lighting, wiring, water heating, electric and gas vehicles, solar, small hydro, wind, wood, and biomass)	J.E. Elliott, P.Eng.	(663-3285)
*APPLICATIONS ENGINEERING (primarily commercial and industrial — including associated total-energy district and waste water applications; electric and gas vehicles, and power factor and demand control)	M.W. Bodnar, P.Eng.	(663-3288)

Please don't hesitate to contact us should you require additional information or should you have any suggestions on how we can better provide the service required.

R.W. RACINE, P.ENG.
MANAGER, ENERGY USE ENGINEERING DEPARTMENT
(604)663-3268 (TELEX 0454395)

ENERGY USE ENGINEERING DEPARTMENT
ENERGY CONSERVATION DIVISION
B.C. HYDRO AND POWER AUTHORITY

625 HOWE STREET
VANCOUVER, B.C.
V6C 2T6

PROJECT 8109

HIGH EFFICIENCY GAS FURNACE FIELD TESTS
INTERIM REPORT
1983

SYNOPSIS:

Preliminary results indicate that new high efficiency natural gas heating equipment replacing existing furnaces (conventional atmospheric burner type with standing pilot) can reduce space heating energy consumption by 20% to 40%. Results for new intermediate efficiency (non-condensing) equipment indicate savings in the range of 15% to 25%. Monitoring is continuing to obtain more specific data on savings, equipment reliability and results for newer equipment.

The new high efficiency equipment, because of its construction, is more expensive than conventional furnaces and its economic viability will depend on its energy savings and equipment life.

PROJECT:

Initiated/Requested by: J. M. Bond
Dated Completed: October 1983
Completed by: W. D. Barchard/J. M. Bond, P.Eng.
Supervised by: Z. El-Ramly, P.Eng.

Approved by: RWRacine
R. W. Racine, Manager
Energy Use Engineering

Initial Distribution: T. J. Newton, A. H. MacPherson, K. Henderson, N. Henderson, R. T. Martin, EUE Supervisors, A. Rose, E. H. Williams, H. F. Robertson, D. A. Ross, J. H. Mitchell, K. Curley, W. A. Pevecz, S. D. MacDonald, D. Rankin, P. E. Dempster, R. A. Wagner

JR74.1

Canadian Cataloguing in Publication Data

Main entry under title:
High efficiency gas furnace field tests

"Project 8109".
ISBN 0-7719-9348-X

1. Gas-burners - Fuel consumption. 2. Gas - Heating and cooking. I. B.C. Hydro. Energy Use Engineering Dept.

TH7466.G3H53 1983 697'.07 C83-092309-8

ENERGY USE ENGINEERING DEPARTMENT

PROJECT SUMMARY

PROJECT NO. 8109 **PRIORITY** 3

TITLE: HIGH EFFICIENCY GAS FURNACE FIELD TESTS

INITIATED/REQUESTED BY: J. M. Bond

ASSIGNED TO: J.M. Bond/W.G. Barchard **ASSIGNED BY:** Z. El-Ramly

DATE ASSIGNED: 27 April 1981 **DATE REQUIRED:** June 1982

ESTIMATED COMPLETION: June 1982 **COMPLETED:**

OBJECTIVES AND NOTES:

Make field tests of the High Efficiency Furnaces now available in British Columbia to:

a) assess their energy saving potential;
b) provide a basis for advice to customers; and
c) determine if and how their use should be promoted.

Test and compare the energy use of a high efficiency gas furnace with that of a conventional gas furnace when operated in a typical residence.

Monitor the first 30 or so installations (in cooperation with the supplier) and calculate savings as compared to the calculated consumptions for conventional gas furnaces.

Perform heat loss calculations to determine C factors to be used for these furnaces.

Utilize the existing Data Extraction and Analysis System to the greatest extent possible.

Complete in accordance with D.G. 800 series of Department Guides.

COPIES TO: DEPARTMENT MANAGER (THEN RECORD FILE), BLUE FILE, SUPERVISOR, W.M. Hannula, G. Hargreaves, R.T. Martin, N. Henderson, R.A. Wagner, E.H. Williams, R. Schneider

PLEASE ADVISE AS SOON AS POSSIBLE IF CHANGES ARE REQUIRED ABOVE

ENERGY USE ENGINEERING DEPARTMENT
ENERGY CONSERVATION DIVISION

B.C. HYDRO

D76-459(80/6)

CONTENTS

Pages

1.0 SUMMARY 1

2.0 INTRODUCTION 2

3.0 CHOOSING TEST HOMES 4

4.0 SUMMARY OF UNITS TESTED 6

5.0 SUPPLY AND INSTALLATION OF FURNACES 7

6.0 MONITORING 8

7.0 RESULTS 11

    7.1 Clare Megasave I Condensing Furnace
    7.2 ICG Condensing Furnace
    7.3 Amana HTM Non-Condensing Heating System
    7.4 Arkla Recuperative Condensing Furnace
    7.5 Duomatic/Olsen Ultramax Condensing Furnace
    7.6 Airco 8300 Turbo Non-Condensing Furnace
    7.7 Lennox G14 Condensing Furnace
    7.8 Hydro Pulse Condensing Boiler
    7.9 Kool-Fire Heat Pump/Condensing Furnace

8.0 DISCUSSION 21

    8.1 Savings
    8.2 Technical Considerations

9.0 RECOMMENDATIONS 25

10.0 CONCLUSIONS 26

11.0 ACKNOWLEDGEMENTS 27

APPENDICES

APPENDIX A - FURNACE DATA AND RESULTS

APPENDIX B - FURNACE DESCRIPTIONS

APPENDIX C - SPECIAL CONSIDERATIONS AND COMMENTS

APPENDIX D - MEMO RE: VALUE TO GAS GROUP (INTERNAL)

APPENDIX E - TEST LOCATIONS (INTERNAL)

1.0 SUMMARY

Thirteen new high efficiency furnaces of various manufacturers are being monitored to assess their potential savings as compared to existing conventional natural gas furnaces. In addition, twenty-eight other high efficiency heating system consumptions are being recorded without detailed metering.

Preliminary indications are that savings in the range of 20% to 40% should be achieved using the new high efficiency equipment in place of existing conventional space heating equipment. Results for new intermediate efficiency (non-condensing) equipment indicate savings in the range of 15% to 25%. Individual results depend, of course, on the condition of the original furnace and on the high efficiency equipment used. Claimed efficiencies for the new equipment range from 83% to 98%.

The new equipment is generally more complicated than conventional equipment and a number of problems, mostly minor in nature, have arisen. As manufacturer's make the minor changes required and installers become more familiar with the requirements of the new equipment, installation and operating problems should become less common and minor in nature.

While solutions to the problems occurring so far have generally been simple and inexpensive, this project has not demonstrated the long-term durability of the new products. There is some concern about corrosion caused by the acidic condensate on some particular furnace components.

2.0 INTRODUCTION

After many years of relatively little change in residential natural gas space heating equipment, we are now experiencing a proliferation of new, more efficient furnaces and boilers. In the late 1970's several manufacturers introduced flue dampers and spark ignition systems which were used to improve the seasonal efficiency of what were essentially conventional furnaces. Any potential improvement in steady state efficiency was restricted by the fact that if they extracted too much heat from the flue gases, the gases would be cooled to the point that condensation of water vapour (a product of combustion) in the flue gases would occur. This could not be allowed because such condensate is acidic and would corrode vent pipes and heat exchangers.

In the late 1970's the Canadian Gas Research Institute (CGRI) and several North American equipment manufacturers were working on designs for space heating equipment which would condense much of the water vapour in the flue gases without causing problems with corrosion. This equipment could then be significantly more efficient than non-condensing types.

The solution generally arrived at, was to use induced draft fans to draw flue products through successive heat exchangers. Corrosion resistant materials were used for vents and for heat exchangers subject to condensation. A number of different heat exchangers were developed with most units using conventional burners and combustion chambers, while two (Hydrotherm Hydropulse Boiler and Lennox G14 Furnace) utilize a pulsed combustion system.

Early in 1981, a few manufacturers had begun to market their new products and it was evident that the introduction of more products was imminent. The manufacturers quoted very high seasonal efficiencies and potential savings for this equipment and it was obvious that B. C. Hydro would be getting many inquiries concerning these claims. The operating characteristics and maintenance requirements of this equipment was also largely unknown.

In order to inform B. C. Hydro personnel and enable them to give information to customers, product data sheets were issued for the equipment initially available (P 2000 series - see Appendix B). However, efficiencies (and therefore savings) quoted by manufacturers were generally based on the U. S. Department of Energy Testing and Calculation Procedure for determining the seasonal efficiency of residential furnaces and boilers. The seasonal efficiency figures quoted by most manufacturers are very high, often in the 90-96% range. Because these figures are so high it was felt that perhaps the calculated efficiencies, while being useful for comparison purposes, would not accurately predict savings as compared to conventional equipment when actually operated in a home. The problem of predicting savings is compounded by the lack of definitive data on the seasonal efficiencies of conventional furnaces.

This project was therefore initiated to field test the new products with the primary goal of assessing their energy saving potential.

Due to the added complexity and extra heat exchanger cost as well as the induced draft fan cost, the condensing furnaces are considerably more expensive than standard units. As the project progressed, other manufacturers brought out improved furnaces which did not quite cool the flue gases to the point of condensation. We call these intermediate efficiency furnaces (although the manufacturers may call them high efficiency since there is no universally accepted definition of this term) and typically they are less expensive than the condensing units. A few furnaces of this type which appeared to be significantly different from conventional units were included for test purposes. It is not yet clear which type of furnace will be most successful in the marketplace.

It was decided that the most practical way to assess the potential savings of a high efficiency furnace as compared to a standard unit was by direct comparison. In order to minimize the effects of residents' lifestyle, house air leakage rates, different system efficiencies and inaccuracies in determining house heat losses, it was decided that new furnaces would be installed to replace existing conventional furnaces for which a consumption history was available. The comparison between the furnaces would thus be made using the same home, same occupants, same ductwork, with adjustments made for variations in weather.

Suitable test homes were chosen and their existing conventional gas furnaces replaced with the high efficiency test units. B. C. Hydro's Metropolitan and Fraser Valley Gas Customer Service Sections personnel performed most of the furnace installation and troubleshooting work for this project.

Existing thermostats were generally retained in order to achieve the most valid comparisons possible. The furnace natural gas consumptions were corrected for heating degree days and the results with the old furnaces and the new furnaces compared to determine the savings.

For some installations, flue gas analyses were made and efficiencies calculated for the new furnaces. The amount of condensate from one condensing furnace was measured continuously and spot checks were made on some others and the amount of heat obtained from the condensed water vapour was calculated. This procedure will be repeated for other condensing furnace models. A second condensate measuring tank was recently installed on another furnace.

3.0 CHOOSING TEST HOMES

In choosing test homes, some of the considerations were as follows.

1. The home should be fairly typical of existing construction and should have a conventional gas furnace.

2. The occupancy should be fairly typical, although a range of family sizes was considered acceptable.

3. Consumption records for natural gas must be available. Initially, homes with furnaces being the only gas appliance were chosen because their space heating gas usage was then known exactly. This criterion was relaxed later on in the project because most of the homes meeting it had been converted from oil space heating and a broader range of home types and ages was desired.

4. Customer interest and willingness to put up with some inconvenience and willingness to read the meters was also considered. In addition, the customer was asked to agree not to make changes in the house for two years so that our furnace comparison would be valid.

5. The home must meet certain physical requirements related to the new furnace. Some condensing furnaces are significantly larger than conventional gas furnaces so floor space and ductwork compatibility had to be considered. In addition, the location of a drain for the condensate and the physical arrangement for venting the furnace were assessed (the condensing furnaces are generally vented through a wall rather than through the roof).

Initially, the furnaces were installed in customers' homes. However, on one particularly complex type of installation it was felt necessary to use detailed instrumentation in order to assess the system more accurately. Due to the complexity (and cost) of the monitoring system it was desirable to have the occupant involved in the monitoring and it was decided to install one unit in the home of a heating and air conditioning engineering section employee. This worked out well not only in terms of involvement with the monitoring system, but also in terms of getting other types of information such as installation time, complexity and problems; operating problems and peculiarities; and quality of results achieved by the heating system. From the results obtained from this home, it became apparent that much more information could be obtained from Heating Section personnel than from the average homeowner. It was decided that it would be desirable that one furnace of each type not already tested be installed in the home of an employee in the Heating Section, provided it met the necessary criteria. It was also desirable to have the first furnace of each type installed in the employee's home in order that installation and operating peculiarities could be identified and any necessary adaptations designed before furnaces were installed in customers' homes. This would then minimize inconvenience to customers participating in the program.

Following this first employee installation, one unit of a different manufacturer was installed in another employee's home. Again, considerable information on installation problems and their possible solutions was obtained. A calibrated condensate tank was installed in this home, and additional monitoring equipment will be installed in the future. A third different unit was subsequently installed in an employee's home and again additional information was obtained.

4.0 SUMMARY OF UNITS TESTED

The "testing" being done in this project is highly variable between installations. Some furnaces were installed by B. C. Hydro personnel, along with special metering in specially selected homes which met criteria which were desirable for comparative purposes. In other cases, B. C. Hydro installed metering on equipment installed by others in homes which met no special criteria. In still other cases, we only know the locations of particular equipment installations and consumptions are being monitored by the existing billing meters.

Our testing is aimed only at determining energy use and potential savings and should not be assumed to be any form of safety or durability test.

The following equipment is currently being tested as part of this project. Manufacturer's information is included in Appendix B.

1. Clare Brothers Limited, Megasave I high efficiency condensing gas furnace. Three units are under test.
2. ICG Manufacturing Ltd., high efficiency condensing gas furnace. Five units are under test.
3. Arkla Industries Inc., recuperative high efficiency condensing gas furnace. Two units are under test.
4. Amana Refrigeration Inc., HTM Plus space and water heating system (intermediate efficiency). Five units, three for space and water heating and two units for space heating only are under test.
5. Hydro-Therm Inc., Hydropulse high efficiency condensing boiler. Nine units are being monitored with no special metering.
6. Airco Products Turbo 8300 intermediate efficiency gas furnace. Six units are being monitored with additional metering.
7. Lennox Industries Inc., G14 high efficiency condensing gas furnace. Two units are being monitored with additional metering.
8. Kool-Fire heat pump/condensing gas furnace. Eight units are being monitored with no special metering.
9. Duomatic/Olsen Ultramax high efficiency condensing gas furnace. One unit under test.

5.0 SUPPLY AND INSTALLATION OF FURNACES

The manufacturers of the new furnaces were generally very interested in the project which would demonstrate the savings available with their products. To date, several manufacturers have supplied one or more units for testing at no cost and further units at a special reduced cost.

The furnace installations done specifically for this project were generally performed by B. C. Hydro gas fitters. Both the Metropolitan Gas and Fraser Valley Gas Customer Services Sections have made very substantial contributions to this project. Other installations were done by contractors and paid for by participating homeowners.

The work involved in replacing an existing furnace with a condensing furnace would typically consist of the following:

- removal of the existing furnace;
- installation of the new furnace;
- installation of a duct transition to the warm air plenum;
- installation of a connector section to the return air plenum;
- removal of existing furnace and water heater vent connectors;
- reinstallation of the water heater vent connector complete with transition connector to the vent;
- installation of a new vent for the furnace horizontally through the wall;
- installation of condensate drain lines;
- reconnection of natural gas piping and electrical power supply.

For the purposes of this project, the following were also done:

- installation of a water meter on the inlet to the water heater;
- installation of a gas meter on the water heater;
- installation of a condensate measuring tank (in two installations);
- installation of thermocouples and a datalogger to measure house, outdoor and system temperatures. This was done for one installation and will be moved to one or two more.

Intermediate furnaces, in general, do not require a condensate drain, and can be co-vented with gas-fired water heaters, usually allowing existing vents to be reused.

The Amana system has all gas connections outside the home. Gas connections are simple and venting is part of the packaged unit. However, these require piping between the outdoor unit and the indoor unit (and the water heater, if used) for the glycol solution.

6.0 MONITORING

Metering was chosen for each house according to the requirements of the particular installation. In the simplest case, the furnace was the only natural gas appliance, so that the existing gas meter was all that was necessary. In some cases, however, elapsed time meters were used to measure hours of operation and kilowatt-hour meters used to measure the furnace fan electrical consumption.

In homes where there were gas-fired water heaters or natural gas fireplaces, meters were also added to determine the consumption of this equipment. Where water heaters were monitored, water meters were installed to measure the amount of hot water used.

A calibrated plastic holding tank has been installed in two houses to measure the amount of condensate produced by the condensing furnaces. It is planned to move these tanks to other homes for condensate measurements for different furnace types. Condensate measurement, together with the corresponding gas consumption will provide a basis for an approximate calculation of efficiency.

Additional monitoring was done on one Amana space heating and water heating unit in an employee home. In this case, a datalogger was used to collect temperature data from various points in the system, as well as indoor, outdoor and domestic hot water temperatures. This data will be combined with flow measurements for the heat system's water/glycol solution to evaluate the system performance for space heating and water heating. A small microcomputer has been purchased to operate in conjunction with the datalogger to perform computerized analysis and data storage functions. This will be installed on completion of the necessary software development.

After an initial run-in and data collection period, this detailed monitoring system will be moved to a few other homes where more detailed information is desired.

A multichannel chart recorder will be installed in one employee home to measure combustion air, return air, supply air and flue gas temperatures. This data, together with approximate measurements of air flow will provide the basis for a calculation of furnace efficiency. This test setup will also be moved to other houses.

Not all installations being monitored were installed on the same basis. The sections on "Description", "Choosing Test Homes" and "Supply and Installation of Furnaces" describe the process of selecting homes, obtaining furnaces, and installing them for test locations over which B. C. Hydro had control. However, not all manufacturer's donated equipment for test purposes and it was not considered cost effective to purchase substantial numbers of furnaces and boilers and have them installed for test purposes.

The equipment manufacturers were cooperative in supplying the locations of equipment they had sold so that owners could be contacted, and if they were interested, meters could be installed. These homes were often not ideal candidates for the tests but since the cost of adding them to the project was small, it was felt to be an efficient means of getting data.

In other instances, persons interested in the project who occupied suitable test homes purchased heating units which B. C. Hydro personnel installed, subject to the standard requirements that metering could be installed, metering equipment would be looked after and readings would be taken by the homeowner.

It is anticipated that the quality of data obtained from different groups of homes will not be the same due to peculiarities of the homes, lack of previous records of energy consumptions, changes to the home, and lack of detailed metering.

Because of these differences, it is useful to group the installations so that the assessment of results can take into account that there is less confidence in some results. The grouping of installations is as follows:

Type A - The house meets the main criteria set for test homes, past gas records are available and sufficient metering equipment installed to uniquely identify space heating energy use. In some cases, considerably more metering is used.

Type B - The house may not meet the criteria for test homes, past records may be only partially valid, sufficient metering equipment is installed.

Type C - Past consumption records may not exist (often a new home), details of the home are known but do not necessarily meet the set criteria, no special metering installed (i.e. billing meters only).

Type D - Past consumption records may not be available, details of the home are not known, no special metering installed. Data from these homes is not included in analysis as it will be of statistical value only. In future, with additional information about the home heat loss and energy use, these installations can become Type C.

Appendix A lists the test installations showing the furnace types and classifications shown above.

Most of the metering installed for this project is located inside the test homes, usually in the basement. This arrangement, combined with the scattered locations of the test homes (they are in ten different municipalities in the Lower Mainland of B. C.) would make the reading of the meters by B. C. Hydro personnel very time consuming and therefore expensive.

The project has been set up so that the residents of the homes can read the meters. Each homeowner has the meter reading procedure explained to him and is given a set of cards on which to record the readings. The cards are appropriately addressed and postpaid so that the homeowner can simply drop them in a mail box. Meter readings were requested to be taken once a month.

This method of data collection has worked very well with installations in B. C. Hydro employee homes but has met with mixed success in other homes. In these cases, data collection, overall, has been judged to be inadequate. Problems identified have been:

(a) inaccurate meter readings;
(b) residents reading the wrong meters;
(c) residents forgetting to read meters;
(d) residents forgetting how to read meters.

In order to minimize these problems, a review of data collection for each installation is being made. Where problems are identified, a site visit will be made, the meters will be clearly identified and the homeowner shown again how to read the meter. At the same time, he will be shown preliminary results for his home to stimulate his interest and demonstrate the importance of the meter readings. In addition, consideration will be given to mailing the homeowners one meter reading card each month to remind them to take readings.

7.0 RESULTS

Table 1 is a summary of the average calculated savings produced by the new furnaces as compared to the conventional equipment originally used in the test homes. It should be considered preliminary as it is based on limited data for a limited number of furnaces.

Furnace Type	Average Saving %	Number of Units Analyzed
A. HIGH EFFICIENCY		
Clare Megasave	23	3
ICG	34	3
Arkla Recuperative	40	2
Lennox G14	37	1
B. INTERMEDIATE EFFICIENCY		
Amana HTM	23	5
Airco 8300	19	2

TABLE 1: SAVINGS IN NATURAL GAS SPACE HEATING CONSUMPTION

The numbers in Table 1 should not be used to decide that one particular furnace is better than another. Variations in the efficiencies of the original equipment will affect the savings achieved by the new equipment. As more data becomes available for a larger sample size, this table will be revised.

Brief descriptions of furnaces and summaries of costs, savings, problems and comments follow. Appendix A contains detailed data for each test installation. For more detailed descriptions of the heating units, see Appendix B. For discussion of special considerations and problems encountered, see Appendix C.

7.1 CLARE MEGASAVE I (CONDENSING) FURNACE
Claimed Efficiency 93%

7.1.1. Description

This physically large furnace (36" wide x 30" deep x 54" high) achieves high efficiency by using three heat exchangers in series. It has a drum type primary heat exchanger with a secondary built around it and a stainless steel finned tube tertiary exchanger located in a separate section of the furnace. An induced draft fan provides venting through a 2" PVC plastic pipe. Condensate formed is run to a floor drain. Electronic ignition eliminates a standing pilot.

Input ratings available are 50,000, 60,000, 70,000 and 80,000 Btu/h.

7.1.2 Number of Units Monitored

Three, the first installed in September 1981.

7.1.3 Savings Achieved

Initial indications are that these units reduced natural gas consumptions by approximately 23% as compared to the conventional furnaces previously used in the test homes.

7.1.4 Approximate Furnace Installed Cost

Average installed cost to replace an existing furnace on existing ductwork is reported to be $2,800.

7.1.5 Problems Encountered

Problems encountered were fan and blower sheaves falling off, a fan shaft being cut in half, vibration noise, noise from an induced draft fan, sheet metal of furnace rattling and condensate leaks inside the furnace from a poor gasket.

Two serious problems occurred with this model furnace. These were slippage of insulation between the cross header from the secondary to tertiary heat exchanger and corrosion of fasteners. These are discussed in detail in Appendix C.

7.2 ICG HI-BOY UPFLOW MODEL HCA (CONDENSING) FURNACE
Claimed Efficiency 95%

7.2.1 Description

This model of ICG's high efficiency furnace is physically large (26" wide x 35-3/4" deep x 60" high) and utilizes three heat exchanger sections in series, with the third heat exchanger being made from stainless steel. The furnace must be ordered as either left or right-hand side return air and cannot be changed over in the field. Venting is horizontal through a 2" ABS plastic pipe. Condensate is run to a drain from the bottom of the stainless steel heat exchanger and the bottom of the vent pipe. Electronic ignition eliminates a standing pilot.

Sizes are available from 60,000 to 100,00 Btu/h input.

7.2.2 Number of Units Monitored

Five, the first installed in January 1982.

7.2.3 Savings Achieved

Initial indications are that these units reduced natural gas consumptions by approximately 34% as compared to the conventional furnaces previously used in the test homes.

7.2.4 Approximate Furnace Installed Cost

Installed costs are reported to be averaging $2,800 to replace an oil or gas furnace on existing ductwork.

7.2.5 Problems Encountered

These furnaces were supplied to B. C. Hydro on the understanding that they were still partly experimental and not yet CGA approved. A number of problems occurred but were generally resolved fairly quickly. These are detailed in the discussion and Appendix C.

7.3 AMANA HTM PLUS (SPLIT 2 OR 3 PART SYSTEMS, NON-CONDENSING) FURNACE
Claimed Efficiency 83%

7.3.1 Description

The Amana system consists of three units.

1. An outdoor section which burns natural gas to heat a water/glycol solution which is then circulated through the indoor sections. The burner is a pre-mix type with combustion taking place on a stainless steel radiant "grid". Ignition is electrical. Though not condensing, the flue gas leaves the top of the unit via a built-in vent cap, very close to dew point temperatures.

2. An indoor section which is a cabinet containing a blower and a finned coil through which hot solution circulates to transfer heat to a standard warm air distribution system.
3. An optional 33 Imperial gallon water heating tank containing a finned tube heat exchanger through which hot solution circulates to transfer heat to the water in the tank. Control is by a priority demand thermostat. The control gives preference to water heating needs over space heating.

Input ratings of 80,000, 100,000 or 120,000 Btu/hr are selectable.

7.3.2 Number of Units Monitored

Five, two heating only and three with the water heating option.

7.3.3 Savings Achieved

(a) Heating Only

Preliminary indications are that these units reduced natural gas consumptions by approximately 23% as compared to the conventional furnaces previously used in the test homes.

(b) Water Heating

There is insufficient data to report on water heating savings at this time.

7.3.4 Approximate Furnace Installed Cost

The installed cost with water heater is $4,000 to $4,700 ($3,000 to $3,700 without the water heater). This is for the replacement of an old furnace while retaining the existing ductwork.

7.3.5 Comments

There are indications that due to the much greater availability of hot water from the Amana domestic water heating systems, residents may be using more hot water. Previous hot water consumption figures are not available.

7.3.6 Problems Encountered

Problems encountered with these units so far have been related to systems with the domestic water heating option. The first system installed had a single-walled heat exchanger for heating domestic water and difficulty was encountered in obtaining the appropriate propylene glycol solution.

Noise from the operation of the three-way valve which controls the flow of solution either to the water heating or space heating unit has been an annoying though not serious problem.

These problems are discussed in more detail in Appendix C.

7.4 ARKLA RECUPERATIVE (CONDENSING) FURNACE
Claimed Efficiency 86-88%

7.4.1 Description

This condensing furnace uses a standard clamshell primary heat exchanger in parallel with a stainless steel secondary clamshell exchanger modified by having a closed bottom so as to be water tight. An induced draft fan is used to provide positive venting through stainless steel 3½ inch vent pipe which can be run horizontally or vertically. Condensate is run to a drain from the bottom of the stainless steel heat exchanger and the bottom of the vent pipe. A second drain, located slightly higher in the heat exchanger, provides a warning of any blockage in the primary drain. Electronic ignition eliminates a standing pilot.

Input ratings available are 50,000, 70,000, 85,000 and 105,000 Btu/h.

7.4.2 Number of Units Monitored

Two, both installed in November 1982 with full metering.

7.4.3 Savings Achieved

Indications are that these units saved approximately 40% over the conventional furnaces previously used in the test homes.

7.4.4 Approximate Furnace Cost

The units under test were installed by B. C. Hydro personnel. We have no information on contractor's installation costs. Suggested retail price for the unit is about $2,000.

7.4.5 Problems Encountered

A thermostat/control circuit mismatch occurred when existing thermostats were retained. This is the same problem as occurred with some other furnace types and is explained in the discussion.

This furnace tends to produce more "steaming" at the vent than the other condensing furnaces. Venting considerations are examined in the discussion and Appendix C.

7.5 DUOMATIC/OLSEN ULTRAMAX (CONDENSING) FURNACE
Claimed Efficiency 95%

7.5.1 Description

This condensing furnace uses a standard clamshell primary heat exchanger, a stainless steel clamshell secondary heat exchanger and a stainless steel finned tube tertiary heat exchanger. An induced draft fan is used to provide positive venting and pre-purge through a 2 inch ABS plastic vent. Condensate is run to drain from the bottom of the heat exchanger and bottom of the vent pipe. Electronic ignition eliminates a standing pilot.

Input ratings available are 60,000, 70,000, 80,000 and 90,000 Btu/h.

7.5.2 Number of Units Monitored

One, installed in April 1983 with full metering.

7.5.3 Savings Achieved

There is insufficient data to estimate savings.

7.5.4 Approximate Furnace Installed Cost

It is estimated that to install this furnace, a replacement for an existing unit would cost approximately $2,800 to $3,000.

7.5.5 Problems Encountered

A minor noise problem with the induced draft fan was easily corrected.

7.6 AIRCO 8300 TURBO (NON-CONDENSING) FURNACE
Claimed Efficiency 83%

7.6.1 Description

Airco 8300 is based on the standard gas furnace design modified to increase both combustion and seasonal efficiency. The standing pilot is eliminated and replaced with spark ignition to eliminate pilot consumption. Natural venting and the draft diverter have been eliminated and replaced by a controlled venting induced draft fan (to reduce excess air and standby venting losses); venting temperatures are about 250-300°F.

The standard gas vent is replaced with a 3 inch vent connector on the 60,000 to 115,000 Btu/h input models which can be co-vented with a standard "B" vent if sized to standard "B" vent sizing tables. The 8300 can be horizontally vented through the wall with special material flex pipe and vent cap.

Input ratings available are 60,000, 75,000, 90,000, 100,000, 110,000, 115,000 and 150,000 Btu/h.

7.6.2 Number of Units Monitored

Five units have been installed between November and December 1982. All units were supplied and installed by the manufacturer in their own employees' homes. B. C. Hydro supplied extra meters and performed heat loss calculations.

7.6.3 Savings Achieved

Estimated savings for two of these units averaged 19%.

7.6.4 Approximate Furnace Installed Cost

$1,850 to $2,200 installed cost to replace an existing furnace using existing ductwork.

7.6.5 Problems Encountered

B. C. Hydro has not been directly involved with any of the Airco 8300 installations. We were informed of an induced draft fan gasket leak which has been rectified.

7.7 LENNOX G14 PULSE COMBUSTION (CONDENSING) FURNACE

Claimed Efficiency 91-98%

7.7.1 Description

This high efficiency furnace is the only furnace currently using the pulse combustion principle. Heat exchangers are in series with the air stream and consist of a combustion chamber (with fins), a tail pipe and decoupler/heat exchanger and a fin tube stainless steel heat exchanger in which the condensation of the flue gas water vapour occurs. The low temperature flue gas is vented horizontally or vertically by a 2 inch PVC pipe. Combustion air is supplied by a similar pipe. The condensate is run to a drain via a small plastic pipe from the tertiary heat exchanger. Ignition is achieved electrically using a spark plug and combustion then continues using the pulsed combustion principle.

Input ratings available are 40,000, 60,000 and 80,000 Btu/h.

7.7.2 Number of Units Monitored

Two, neither of which were installed by B. C. Hydro. Neither will provide definitive consumption records due to the nature of the homes.

7.7.3 Savings Achieved

Savings achieved for one of these units have been estimated at 37%.

7.7.4 Approximate Furnace Cost Installed

Initial installed price for this furnace fluctuated greatly. As of January 1983, the average cost to replace an existing gas or oil furnace was about $4,200.

7.7.5 Problems Encountered

B. C. Hydro was not involved in the installation of these units and thus has no first-hand knowledge of installation or operating problems.

From field observations and discussions with installers, it is apparent that noise attenuation must be a major consideration with these units.

7.8 HYDROPULSE A50 AND A100 PULSE COMBUSTION (CONDENSING) BOILER Claimed Efficiency 91-94%

7.8.1 Description

This hot water boiler is built as a cylinder 14 inches in diameter and 34½" or 48" tall for the two models respectively. The inside top, bottom and sides are heavily soundproofed with a concrete-like material to provide attenuation of the combustion noise. A stainless steel coiled fire tube is immersed in the boiler water and has a condensate drain at the bottom from which water condensed from the flue gases is run to drain. One PVC pipe supplies combustion air to the unit from outside while another vents the flue gases at a low temperature. These pipes can be run horizontally or vertically. Ignition is achieved electrically using a spark plug and combustion then continues using the pulsed combustion principle.

A water heating option is available using an immersion coil in an insulated tank to provide a high recovery capacity. The boiler can also be used in a forced warm air system using the fan in an existing furnace and adding a finned tube water coil at the bonnet.

Input ratings available are 50,000 or 100,000 Btu/h.

7.8.2 Number of Units Monitored

Nine system consumptions are being recorded, but Hydro has no extra test meters installed and was not involved in any installations. Only one home has a previous gas history.

7.8.3 Savings Achieved

It will not likely be possible to do a comparative analyses on many of these homes to calculate savings. In the future, comparisons may be made between actual and estimated consumptions. It may be possible in future to install one installation in a good test home to class A monitoring standards.

7.8.4 Approximate Boiler Installed Cost

Prices of installing hot water boilers tend to vary considerably but indications so far are that the boiler installed cost would run approximately $3,500 to replace an existing boiler and about $4,500 with the water heater option providing other extensive changes were not done at the same time.

7.8.5 Problems Encountered

B. C. Hydro was not involved in the installation of these units and thus has no first-hand knowledge of installation or operating problems.

7.9 KOOL-FIRE HEAT PUMP/CONDENSING GAS FURNACE

Claimed Efficiency 98% as a condensing gas furnace

7.9.1 Description

This machine operates as a split system heat pump during moderate weather and as an electrically assisted condensing gas furnace during below-freezing conditions. This approach to a high efficiency heating system consists of an outdoor unit containing a compressor, a fan and a gas burner and an indoor fan/coil cabinet. In moderate weather, the unit functions as an air source split system heat pump. In cold weather, the outdoor burner fires and becomes the heat source for the heat pump. Most of the heat from the gas flame is transferred by the heat pump to the indoor air. The gas burner is normally not used until air temperature drops below 40°F.

Models of 24,000, 32,000 and 79,000 Btu/h gas input are available.

7.9.2 Number of Units Installed

We are recording total home electric and natural gas consumptions for eight installations, but have installed no special metering.

7.9.3 Savings Achieved

While it will not be possible to accurately calculate savings for these homes, a statistical evaluation can be made. Detailed metering for these homes would be expensive and some future Kool-Fire installation may provide a better evaluation of savings.

7.9.4 Approximate System Cost Installed

The only cost records we have are for the complete system including ductwork and gas water heater at $6,060 each. The suppliers estimate that to replace an existing oil or gas furnace, costs would be $4,800 to $5,200 using existing ductwork.

The Kool-Fire system is not just a high efficiency heating system, but a central heating and cooling system. Therefore, costs cannot be directly compared to installation costs of high efficiency furnace systems.

7.9.5 Problems Encountered

B. C. Hydro was not involved in the installation of these units and therefore have no knowledge of installation and operating problems.

8.0 DISCUSSION

8.1 SAVINGS

The savings measured in this project are for new furnaces replacing existing ones. The existing furnaces (with one exception) were of conventional design with atmospheric burners and standing pilots. The existing furnaces varied in age and condition from approximately two years old in excellent condition to many years old and due to be replaced. In addition, homeowner habits regarding furnace maintenance and adjustments and filter cleaning likely varied considerably.

This point does not affect the validity of results for assessing the potential savings available through the replacement of existing furnaces with new high efficiency ones, except that savings may decrease slightly with time as the new equipment becomes dirty and/or poorly maintained.

In a direct comparison of new high efficiency furnaces to new conventional furnaces, however, the savings for the high efficiency furnaces may prove to be slightly lower than those measured in this project. Project 7852 "Furnace Tuning Project" reports that significant savings (up to 15%) may be achieved by cleaning, adjusting and replacing filters on older existing natural gas furnaces. Although the results of the furnace tuning program would not be directly applicable to this project, it is reasonable to assume that the replacement of the original furnaces in this project with new conventional furnaces would also have produced some savings.

The period of analysis to date has been over an unusually mild winter. The reference year (1981/82 heating season) was a normal year for heating. Although the savings calculations are degree day corrected, it is well known that heating degree days are only an approximate measure of heating requirements. The savings calculated for this very mild winter may have been less if the winter had been normal or severe. Nevertheless, it is clear that these new furnaces are producing substantial savings as compared to conventional equipment.

The savings identified are based on operation for a limited period of the new high efficiency equipment compared to the previous consumption with the conventional furnace. In the next phase of the project, as more data becomes available, savings will also be calculated by comparing typical and actual consumption factors (C factors) for the homes.

8.2 TECHNICAL CONSIDERATIONS

The new high efficiency furnaces are more complex than standard natural gas furnaces and there are a few extra considerations to be taken into account in their installation.

8.2.1 Controls

A number of instances were encountered in which the standard low voltage thermostat in the test home did not have an anticipator range high enough to accommodate the new furnace. The result was short cycling and "droop". Since, for comparison purposes, it was desirable to retain the existing thermostat, a relay was interposed between the thermostat and the furnace control circuit. In many cases, new electronic night setback thermostats are offered as part of a package with a new furnace and the homeowner would be well advised to take advantage of this, both for the night setback energy savings available and to avoid any possible mismatch with control components.

8.2.2 Venting

The condensing furnaces are generally vented by means of an induced draft fan which discharges the flue gas at a relatively low temperature (95-125°F) through a wall vent. Because they are power vented, these furnaces cannot be co-vented with natural draft gas-fired water heaters (power vented condensing water heaters are not currently available). The flue gases from a furnace which is operating in the condensing mode will be saturated with water vapour and will contain potentially harmful combustion products (as is the case with any fuel burning appliance). It is important, therefore, that the vent location be selected so that the vented gases will not tend to re-enter the home through doors, operable windows, combustion air vents or soffit vents. The vents should not be located within two metres (six feet) of any of these openings and should not be below operable windows.

Even with a well located vent, the condensation of water vapour at the vent termination and on nearby surfaces can pose problems. The amount of "steaming" of the vents varied with different furnace manufacturers, with different vent termination arrangements and with the weather. In cold weather, excessive condensation occurred in some cases, mainly with the Arkla furnaces supplied with a particular vent cap. In two cases, the sides of the houses were subjected to moisture in amounts considered potentially harmful and some of this steam was entering an attic through soffit vents. These problems were solved, at least in the short term, by moving the vents. In one instance, the vent was moved away from vented soffits, extended further out (approximately 18 inches) from the exterior of the wall and had the vent cap replaced with a tee connection. In another instance, a special venting arrangement was constructed to run the new vent up through the roof inside the larger diameter original furnace vent. The water heater was vented through the remaining area of the larger vent. In colder climates, problems have occurred with ice build-up around the vents due to the condensation and freezing of the vented water vapour.

The vents must have adequate slope so that condensate occurring within the vent runs back to the furnace and is drained. The installation must be such that excessive sagging of the vent does not occur because moisture will collect at low points and could block the vent.

8.2.3 Condensate Drainage

The condensate produced by a condensing furnace must be disposed of. In many cases, a floor drain is available in a convenient location, but it was found necessary in some instances to cut and patch parts of concrete floors to gain access to drains. Condensate drainage was generally not a major problem, but there are homes without floor drains where it would be very difficult to get rid of the condensate. The drain connection locations on different furnaces vary somewhat but they are typically less than 0.6 m (2 ft) above the bottom of the furnace. The condensate is acidic and corrosion resisting materials must be used for the drain. The flow rate of the condensate is low enough that 9.5 mm (3/8 inch) plastic tubing can be used for the drain. Depending on the house heat loss, the weather and the particular furnace, the amount of condensate produced will vary from negligible up to about 20 litres (4.4 gallons) per day in the Vancouver area.

8.2.4 Noise

Noise generated by the condensing furnaces is mainly due to the main blower and the induced draft fan. The main blower noise is usually similar to that of a standard furnace and may even be less as many of the new units are using more efficient main blowers with direct drive rather than belt drive.

The noise produced by the induced draft fans, while noticeable, is within the limits generally considered acceptable. The occupants of a few test homes remarked that overall, the new equipment was quieter than their old furnaces.

Problems with loose sheet metal in the furnace casing and with unbalanced induced draft fans resulted in noisy operation in a few cases, until corrected.

The pulsed combustion equipment does not use induced draft fans but has its own potential noise and vibration problems. Extra care in the installation of this equipment is required and recommendations include vibration isolation mounting of the furnace and furnace vents, flexible connections for gas pipe and warm air ducting and accoustical lining of some ductwork. The locations of air inlet and flue gas exhaust outlets require careful consideration and mufflers may be required.

8.2.5 Corrosion

The condensate in condensing (and possibly under some circumstances in non-condensing) heating equipment is acidic (measured pH values have been in the range of 3.5 to 4.0) and all the materials which may be exposed to it must be corrosion resistant. Where protective coatings are used, they must be suitable for the exposure involved (galvanizing and cadmium plating, for example, are not suitable). Most manufacturer's have used stainless steel, plastics and epoxy coated steel for various components.

Even with the precautions taken by the equipment manufacturers and installers some minor corrosion problems have occurred - generally involving improperly protected fasteners, clips and miscellaneous small parts. Minor corrosion has also been noted on a few primary (untreated) heat exchangers but it is not clear if this is a static condition or if there will be progressive deterioration.

A report received from Ontario indicated that some corrosion had occurred in the type 304 stainless steel vents of some Arkla furnaces. This has not become apparent on the units being tested by B. C. Hydro.

One Clare Megasave furnace has incurred severe corrosion damage and is being replaced. Analysis of the corroded material indicated that chlorine was involved. It is well known that halogens in the atmosphere can cause corrosion of furnace heat exchangers, but the condensing furnaces may be particularly susceptible to this corrosion because of their many moist surfaces when in operation. Only further experience will determine if this is the case.

9.0 RECOMMENDATIONS

This project should be maintained on an ongoing basis because of the substantial benefits it produces. The level of activity for the project will vary from year to year according to the requirement for new information and the available budget. A report should be produced each year, summarizing the project activity and the results obtained.

The major benefits arising from this project are as follows.

1. The results provide Energy Use Engineering with a basis for providing advice to Advisory Services personnel and to customers regarding the potential savings, costs, installation requirements and possible operating problems resulting from the use of new products. It thus keeps both appropriate personnel and B. C. Hydro's advice up to date with current developments.

2. The project has supplied a vehicle for training Gas Division field personnel on new equipment more directly and quickly than would otherwise have been possible, making them as expert and experienced as any in the industry. Also, the feedback from our experienced gas fitters and Gas Division personnel, has been invaluable in the evaluation and troubleshooting of this new equipment. Appendix D contains the first page of a memo from B. C. Hydro's Metropolitan Gas Customer Services Section which summarizes the value they place on the testing program.

3. The results provide Energy Use Engineering with data vital to energy use studies for other B. C. Hydro groups - e.g. impact analysis for Load Forecasting.

10.0 CONCLUSIONS

While it is too soon to draw firm conclusions regarding the performance of the new high and intermediate efficiency natural gas heating units, we can make the following statements.

1. The high efficiency (condensing) equipment is significantly more efficient than conventional units. Depending on the specific installation and equipment used, savings should be in the range of 20% to 40%. As more data becomes available, these preliminary figures will become more specific.

2. Several of the high efficiency furnaces were essentially in the prototype stage when this project began. In addition, installers were not familiar with the special requirements for their installation. As a result, more problems were experienced with the new units than would be expected with conventional units. As manufacturer's refine their designs to minimize the (mostly minor) problems and installers become more experienced there should be fewer problems occurring. It should be recognized, however, that the high efficiency equipment is more complicated than conventional furnaces and the long-term durability of the new products has not been demonstrated. Varying degrees of corrosion has occurred in a few units.

3. We would expect the intermediate efficiency equipment to produce slightly smaller savings than the condensing equipment. Results to date tend to confirm this, with the AIRCO units averaging 19% savings and the AMANA units averaging 23%.

4. We realize that based on a seasonal efficiency rating of 65% for conventional gas units, reductions in consumption of more than 35% are not possible. The seasonal efficiencies of conventional systems are not well documented, however, and it is possible that the 65% efficiency is optimistic for actual in-service conditions. Alternatively, the highest savings measured may be in comparison to furnaces which were particularly poorly maintained and operating at lower than average efficiency.

11.0 ACKNOWLEDGEMENTS

The authors would like to acknowledge the very substantial contributions made to this project by both the Metropolitan Gas and Fraser Valley Gas Customer Services Sections of B. C. Hydro's Gas Group who installed most of the furnaces for this project. They also did most of the efficiency tests, combustion efficiency calculations and troubleshooting.

The following furnace manufacturers and distributors also made significant contributions by donating equipment for testing and by helping to solve problems as they arose.

Amana	Werners' Refrigeration Co. Ltd.
Arkla	Inesko Equipment Ltd.
Clare	Ecco Heating Products
Duomatic/Olsen	

The following helped to located new equipment installations for monitoring or provided equipment at reduced cost and provided information on installation and operational considerations.

Airco	Airco Products
Hydro Pulse	Bartle & Gibsons Co. Ltd.
ICG	ICG Energy Products Ltd.
Kool Fire	Astravan Distributors Ltd.
Lennox	Mr. G. Moore and Mr. R. Coleman (Lennox dealers)

APPENDIX A

FURNACE DATA AND RESULTS

FURNACE AND RESULTS SUMMARY

Location Number	New Furnace	Old Furnace	Testing* Class'n	Indicated Savings
Clare #1	Megasave I 60,000 Btu/h Input	Debonaire 90,000 Btu/h Input	A	33%
Clare #2	Megasave I 90,000 Btu/h Input	Intercity 125,000 Btu/h Input	A	15%
Clare #3	Megasave I 80,000 Btu/h Input	Airco 125,000 Btu/h Input	A	20%
ICG #1	ICG (HCA) 60,000 Btu/h Input	Intercity 105,000 Btu/h Input	A	28%
ICG #2	ICG (HCA) 60,000 Btu/h Input	Intercity 100,000 Btu/h Input	A	36%
ICG #3	ICG (HCA) 60,000 Btu/h Input	Chrysler Airtemp 105,000 Btu/h Input	A	39%
ICG #4	ICG (HCA) 60,000 Btu/h Input	Lennox	C	NS Data
ICG #5	ICG Lowboy Condensing	Not Known	D	NS Data
Amana #1	HTM + Water 80,000 Btu/h Input	Weatherwise 160,000 Btu/h Input	A	19%
Amana #2	HTM (Heat Only) 120,000 Btu/h Input	Lennox 120,000 Btu/h Input	A	36%
Amana #3	HTM (Heat Only) 80,000 Btu/h Input	Lennox 120,000 Btu/h Input	A	26%
Amana #4	HTM + Water 120,000 Btu/h Input	Esso (conversion) 94,000 Btu/h Input	A	15%
Amana #5	HTM + Water 80,000 Btu/h Input	Modified Home	B	20%
Airco #1	Airco 8300 80,000 Btu/h Input	Coleman 80,000 Btu/h Input	B	23%
Airco #2	Airco 8300 115,000 Btu/h Input	Gas FWA make not known	B	15%
Airco #3	Large Wood Stove + Airco 8300 115,000 Btu/h Input	Gas FWA make not known	B	NS Data
Airco #4	Airco 8300 75,000 Btu/h Input	Gas FWA make not known	B	NS Data
Airco #5	Airco 8300 115,000 Btu/h Input	Airco 115,000 Btu/h spark and damper	B	NS Data
Airco #6	Airco 8300 75,000 Btu/h Input	Previous Oil	D	NS Data
Arkla #1	Recuperative 50,000 Btu/h Input	Intercity 100,000 Btu/h Input	A	39%
Arkla #2	Recuperative 80,000 Btu/h Input	Smarts 126,000 Btu/h Input	A	42%
Lennox #1	Lennox G14 Pulse 80,000 Btu/h Input	Airco 130,000 Btu/h Input	B/C	NS Data
Lennox #2	Lennox G14 Pulse 60,000 Btu/h Input	Coleman 130,000 Btu/h Input	B/C	37%
Hydropulse #1	Hydropulse - no other data	No Data	D	NS Data
Hydropulse #2	Hydropulse - no other data	No Data	D	NS Data
Hydropulse #3	Hydropulse - no other data	No Data	D	NS Data
Hydropulse #4	Hydropulse - no other data	No Data	D	NS Data
Hydropulse #5	Hydropulse - no other data	No Data	D	NS Data
Hydropulse #6	2 Hydropulse - no other data	No Data (previous oil)	D	NS Data
Hydropulse #7	1 Hydropulse to FWA	Oil FWA No Data	D	NS Data
Hydropulse #8	Hydropulse - no other data	No Data	D	NS Data
Hydropulse #9	Hydropulse and Boiler Mate	New Home	D	NS Data
Kool Fire #1	Kool Fire + Gas DW	New Home	D	NS Data
Kool Fire #2	Kool Fire + Gas DW	New Home	D	NS Data
Kool Fire #3	Kool Fire + Gas DW	New Home	D	NS Data
Kool Fire #4	Kool Fire + Gas DW	New Home	D	NS Data
Kool Fire #5	Kool Fire + Gas DW	New Home	D	NS Data
Kool Fire #6	Kool Fire + Gas DW	New Home	D	NS Data
Kool Fire #7	Kool Fire + Gas DW	New Home	D	NS Data
Kool Fire #8	Kool Fire + Gas DW	New Home	D	NS Data
Olsen #1	Duomatic/Olsen 60,000 Btu/h Input	Moffat J Line 84,000 Btu/h Input	A	NS Data

* See Section 6.0 for explanation of classifications.

NS Data - Data not sufficient for calculation yet.

CLARE #1

FURNACE: Clare Megasave

Input: 60,000 Btu/h
Output: 54,000 Btu/h

PREVIOUS FURNACE: Debonaire

Input: 90,000 Btu/h
Output: 67,500 Btu/h
Measured Combustion Efficiency: not done

HOUSE HEAT LOSS: 38,900 Btu/h

PREVIOUS SPACE HEATING CONSUMPTION

Period: 19 November 1979 to 21 September 1981
Consumption: 1427 BU
Space Heating Degree Days: 5454
BU Per Degree Day: 0.262

NEW SPACE HEATING CONSUMPTION

Period: 19 November 1981 to 19 November 1982
Consumption: 533 BU
Space Heating Degree Days: 3048
BU Per Degree Day: 0.175

PERCENT SAVING: 33%

CLARE #2

FURNACE: Clare Megasave

Input: 90,000 Btu/h
Output: 81,000 Btu/h

PREVIOUS FURNACE: Intercity

Input: 125,000 Btu/h
Output: 93,750 Btu/h
Measured Combustion Efficiency: not taken

HOUSE HEAT LOSS: 91,215 Btu/h

PREVIOUS SPACE HEATING CONSUMPTION

Period: 6 December 1980 to 8 December 1981
Consumption: 1455 BU
Space Heating Degree Days: 2810
BU Per Degree Day: 0.518

NEW SPACE HEATING CONSUMPTION

Period: 9 February 1982 to 9 February 1983
Consumption: 1289 BU
Space Heating Degree Days: 2918
BU Per Degree Day: 0.442

PERCENT SAVING: 15%

CLARE #3

FURNACE: Clare Megasave

Input: 80,000 Btu/h
Output: 72,000 Btu/h

PREVIOUS FURNACE: Airco*

Input: 125,000 Btu/h
Output: 93,750 Btu/h
Measured Combustion Efficiency: 76%

HOUSE HEAT LOSS: 68,700 Btu/h

PREVIOUS SPACE HEATING CONSUMPTION

Period: 30 September 1980 to 30 September 1981
Consumption: 713 BU
Space Heating Degree Days: 2842
BU Per Degree Day: 0.217

NEW SPACE HEATING CONSUMPTION

Period: 30 April 1982 to 30 April 1983
Consumption: 473 BU
Space Heating Degree Days: 2738
BU Per Degree Day: 0.173

PERCENT SAVING: 20%

*This furnace was equipped with spark ignition and flue damper.

ICG #1

FURNACE: ICG Condensing Furnace (HCA)

Input: 60,000 Btu/h
Output: 54,000 Btu/h

PREVIOUS FURNACE: Intercity

Input: 105,000 Btu/h
Output: 78,750 Btu/h
Measured Combustion Efficiency: 75%

HOUSE HEAT LOSS: 53,450 Btu/h

PREVIOUS SPACE HEATING CONSUMPTION

Period: 20 January 1981 to 18 January 1982
Consumption: 786 BU
Space Heating Degree Days: 2910
BU Per Degree Day: 0.270

NEW SPACE HEATING CONSUMPTION

Period: 17 March 1982 to 18 March 1983
Consumption: 553 BU
Space Heating Degree Days: 2830
BU Per Degree Day: 0.195

PERCENT SAVING: 28%

ICG #2

FURNACE: ICG Condensing (HCA)

Input: 60,000 Btu/h
Output: 54,000 Btu/h

PREVIOUS FURNACE: Intercity

Input: 100,000 Btu/h
Output: 80,000 Btu/h
Measured Combustion Efficiency: 75%

HOUSE HEAT LOSS: 56,628 Btu/h

PREVIOUS SPACE HEATING CONSUMPTION

Period: 21 January 1981 to 21 January 1982
Consumption: 759 BU
Space Heating Degree Days: 2958
BU Per Degree Day: 0.257

NEW SPACE HEATING CONSUMPTION

Period: 22 March 1982 to 22 March 1983
Consumption: 460 BU
Space Heating Degree Days: 2805
BU Per Degree Day: 0.164

PERCENT SAVING: 36%

ICG #3

FURNACE: ICG Condensing (HCA)

Input: 60,000 Btu/h
Output: 54,000 Btu/h

PREVIOUS FURNACE: Chrysler Airtemp

Input: 105,000 Btu/h
Output: 78,750 Btu/h
Measured Combustion Efficiency: not available

HOUSE HEAT LOSS: 49,230 Btu/h

PREVIOUS SPACE HEATING CONSUMPTION

Period: 29 December 1980 to 31 December 1981
Consumption: 725 BU
Space Heating Degree Days: 2890
BU Per Degree Day: 0.251

NEW SPACE HEATING CONSUMPTION

Period: 1 May 1982 to 2 May 1983
Consumption: 421 BU
Space Heating Degree Days: 2743
BU Per Degree Day: 0.153

PERCENT SAVING: 39%

AMANA #1

FURNACE: Amana (Heating and Water Heating)

Input: 80,000 Btu/h
Output: 69,600 Btu/h

PREVIOUS FURNACE: Weatherwise

Input: 100,000 Btu/h
Output: 75,000 Btu/h
Measured Combustion Efficiency: (not measured)

HOUSE HEAT LOSS: 64,919 Btu/h

PREVIOUS SPACE HEATING CONSUMPTION

Period: 16 April 1981 to 16 April 1982
Consumption: 1101 BU
Space Heating Degree Days: 3040
BU Per Degree Day: 0.362

NEW SPACE HEATING CONSUMPTION

Period: 21 June 1982 to 17 June 1983
Consumption: 790 BU
Space Heating Degree Days: 2701
BU Per Degree Day: 0.292

PERCENT SAVING FOR SPACE HEATING: 19%

AMANA #2

FURNACE: Amana HTM (Heating Only)

Input: 120,000 Btu/h
Output: 104,400 Btu/h

PREVIOUS FURNACE: Lennox

Input: 120,000 Btu/h
Output: 90,000 Btu/h
Measured Combustion Efficiency: 67%

HOUSE HEAT LOSS: 107,400 Btu/h

PREVIOUS SPACE HEATING CONSUMPTION

Period: 12 May 1981 to 11 May 1982
Consumption: 2046 BU
Space Heating Degree Days: 3040
BU Per Degree Day: 0.673

NEW SPACE HEATING CONSUMPTION

Period: 31 May 1982 to 31 May 1983
Consumption: 1162 BU
Space Heating Degree Days: 2699
BU Per Degree Day: 0.431

PERCENT SAVING FOR SPACE HEATING: 36%

AMANA #3

FURNACE: Amana HTM (Heating Only)

Input: 80,000 Btu/h
Output: 69,600 Btu/h

PREVIOUS FURNACE: Lennox

Input: 120,000 Btu/h
Output: 90,000 Btu/h
Measured Combustion Efficiency: 76%

HOUSE HEAT LOSS: 42,270 Btu/h

PREVIOUS SPACE HEATING CONSUMPTION

Period: 11 March 1981 to 10 March 1982
Consumption: 1030 BU
Space Heating Degree Days: 2975
BU Per Degree Day: 0.346

NEW SPACE HEATING CONSUMPTION

Period: 10 May 1982 to 10 May 1983
Consumption: 697 BU
Space Heating Degree Days: 2731
BU Per Degree Day: 0.255

PERCENT SAVING FOR SPACE HEATING: 26%

AMANA #4

FURNACE: Amana (Heating and Water Heating)

Input: 120,000 Btu/h
Output: 104,400 Btu/h

PREVIOUS FURNACE: Old Oil-to-Gas Conversion (Esso)

Input: 94,000 Btu/h
Output: 78,000 Btu/h
Measured Combustion Efficiency: 83%

HOUSE HEAT LOSS: 79,000 Btu/h

PREVIOUS SPACE HEATING CONSUMPTION

Period: 7 April 1981 to 6 April 1982
Consumption: 1030 BU
Space Heating Degree Days: 3031
BU Per Degree Day: 0.340

NEW SPACE HEATING CONSUMPTION

Period: 6 August 1982 to 8 August 1983
Consumption: 786 BU
Space Heating Degree Days: 2714
BU Per Degree Day: 0.290

PERCENT SAVING FOR SPACE HEATING: 15%

AMANA #5

FURNACE: Amana (Heating and Water Heating)

Input: 80,000 Btu/h
Output: 69,600 Btu/h

PREVIOUS FURNACE: Not Applicable

HOUSE HEAT LOSS: 44,800 Btu/h

ESTIMATED PREVIOUS SPACE HEATING CONSUMPTION

Consumption: 775 BU
Space Heating Degree Days: 3031
BU per Degree Day: 0.256

NEW SPACE HEATING CONSUMPTION

Period: 1 February 1983 to 1 August 1983
Consumption: 232 BU
Space Heating Degree Days: 1126
BU per Degree Day: 0.206

PERCENT SAVING FOR SPACE HEATING: 20% (Estimated, not measured)

ARKLA #1

FURNACE: Arkla Condensing Furnace

Input: 50,000 Btu/h
Output: 44,800 Btu/h

PREVIOUS FURNACE: Intercity

Input: 100,000 Btu/h
Output: 80,000 Btu/h
Measured Combustion Efficiency: 75%

HOUSE HEAT LOSS: 38,800 Btu/h

PREVIOUS SPACE HEATING CONSUMPTION: 490 BU

Period: 29 October 1981 to 27 August 1982
Consumption: 752 BU
Space Heating Degree Days: 2645
BU Per Degree Day: 0.284

NEW SPACE HEATING CONSUMPTION

Period: 16 November 1982 to 31 August 1983
Consumption: 375 BU
Space Heating Degree Days: 2139
BU Per Degree Day: 0.174

PERCENT SAVING: 39%

ARKLA # 2

FURNACE: Arkla Condensing Furnace

Input: 85,000 Btu/h
Output: 74,000 Btu/h

PREVIOUS FURNACE: Smarts

Input: 126,000 Btu/h
Output: 101,000 Btu/h

PREVIOUS SPACE HEATING CONSUMPTION

Period: 22 February 1982 to 19 August 1982
Consumption: 416 BU
Space Heating Degree Days: 1087
BU Per Degree Day: 0.383

NEW SPACE HEATING CONSUMPTION

Period: 21 February 1983 to 23 August 1983
Consumption: 203 BU
Space Heating Degree Days: 906
BU Per Degree Day: 0.224

PERCENT SAVING: 42%

LENNOX # 2

FURNACE: Lennox G14

Input: 60,000 Btu/h
Output: 55,000 Btu/h

PREVIOUS FURNACE: Coleman

Input: 130,000 Btu/h
Output: 104,000 Btu/h

PREVIOUS SPACE HEATING CONSUMPTION

Period: 24 March 1981 to 22 March 1982
Consumption: 1293 BU
Space Heating Degree Days: 3008
BU per Degree Day: 0.430

NEW SPACE HEATING CONSUMPTION

Period: 22 July 1982 to 22 July 1983
Consumption: 741 BU
Space Heating Degree Days: 2719
BU per Degree Day: 0.272

PERCENT SAVING: 37%

AIRCO # 1

FURNACE: Airco 8300

Input: 80,000 Btu/h
Output: 66,400 Btu/h

PREVIOUS FURNACE: Coleman

Input: 80,000 Btu/h
Output: 64,000 Btu/h

PREVIOUS SPACE HEATING CONSUMPTION

Period: 10 October 1981 to 8 October 1982
Consumption: 1279 BU
Space Heating Degree Days: 2977
BU per Degree Day: 0.430

NEW SPACE HEATING CONSUMPTION

Period: 7 December 1982 to 10 August 1983
Consumption: 612 BU
Space Heating Degree Days: 1840
BU per Degree Day: 0.333

PERCENT SAVING: 23%

AIRCO # 2

FURNACE: Airco 8300

Input: 115,000 Btu/h
Output: 95,000 Btu/h

PREVIOUS FURNACE: UNKNOWN

PREVIOUS SPACE HEATING CONSUMPTION

Period: 13 October 1981 to 13 October 1982
Consumption: 1075 BU
Space Heating Degree Days: 2985
BU per Degree Day: 0.360

NEW SPACE HEATING CONSUMPTION

Period: 13 December 1982 to 15 August 1983
Consumption: 539 BU
Space Heating Degree Days: 1760
BU per Degree Day: 0.306

PERCENT SAVING: 15%

APPENDIX B

FURNACE DESCRIPTIONS

P 2001

NEW PRODUCT INFORMATION

SUBJECT: Clare High Efficiency (Condensing) Gas Furnace

A demonstration of this furnace was made for Energy Use Engineering and other B. C. Hydro Gas Group personnel on 10 April 1981. The furnace will be distributed in the Vancouver area by ECCO Heating Products Ltd.

Furnace details are as follows:

Claimed Efficiency	94%.
Weight	Approximately 315 lbs.
Heat Exchangers	Drum type primary with a secondary built around this and a tertiary (a stainless steel finned tube coil) in a separate section of the furnace.
Flue Gas Temperature	Approximately 450°F after the secondary exchanger, 112-115°F after the tertiary exchanger.
Venting	A stainless steel forced-draft fan exhausts flue gases through 2" PVC pipe sloping to return condensate to the furnace. Up to 60 equivalent feet of pipe may be used. Exhaust is normally through the wall with a special cover plate to minimize the effect of wind.
Condensate Drain	Plastic hose with a trap is used to conduct condensate to a drain. A second hose, mounted slightly higher serves as an overflow. The condensate was claimed to have a pH of 4.5 to 6.0.
Operation	A call for heat causes the forced draft fan to operate for a 20 second purge. Two pressure switches, one high pressure (0.7" WG) and one low pressure (0.25" WG) detect flue blockage or fan failure. After the purge a White-Rodgers spark ignition lights the pilot. The pilot then operates the main gas valve (after approximately 45 seconds). After shutting down, the system is purged again.

JDS4.2

SAVE
UP TO
63%

HEAT YOUR HOME FOR LESS

*CUT YOUR FUEL BILL BY UP TO 63% OVER CONVENTIONAL OIL FIRED FURNACES AND UP TO 47% OVER CONVENTIONAL GAS FIRED FURNACES BY INSTALLING †CANADA'S MOST EFFICIENT FORCED AIR GAS FURNACE . . .

MEGASAVE I by **Clare**

† As rated by the Canadian Gas Association as of March 2, 1981.

Save up to 63% over co

HEAT DOES NOT GO UP THE CHIMNEY!

Megasave I is not vented up the chimney; in fact, no chimney is required – in marked contrast to conventional furnaces which lose between 40% and 50% of the heat they produce up the chimney.

FLUE GAS TEMPERATURE OF MEGASAVE I IS SO LOW, IT IS VENTED LIKE A CLOTHES DRIER.

Even with the use of motorized chimney dampers, the flue gases of a conventional furnace enter the venting system at a temperature of at least 450°F (232°C).

LOW FLUE GAS TEMPERATURE PROOF OF EFFICIENCY

The Megasave I extracts the maximum usable heat. In fact, the flue gas temperature leaving the furnace is only approximately 112°F (44°C).

This is absolute proof that every bit of practical, usable heat has been extracted.

CONDENSATION PROOF OF EFFICIENCY

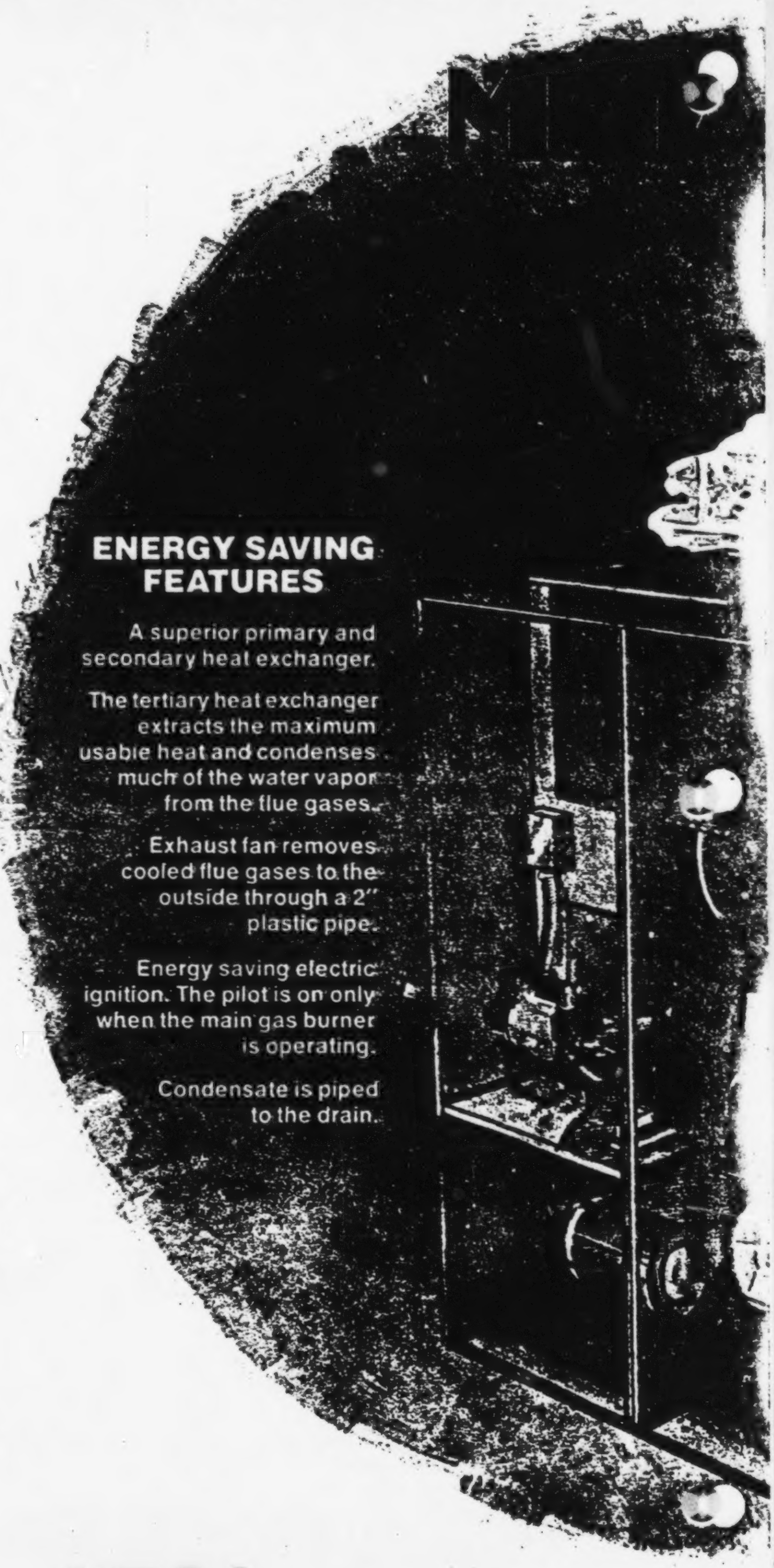
Even under ideal conditions in a laboratory, conventional gas furnaces can only achieve 75-80% efficiency. Because of their design, the flue gases cannot be lowered significantly below the 450°F (232°C) level. Additional heat extraction will cause condensation on the heat exchanger surface and eventual damage to the chimney or flue. If a conventional furnace experiences condensation on heat exchanger surfaces, the resulting corrosion will damage the furnace in short order.

MEGASAVE I CONNECTED TO DRAIN

Megasave I is engineered as a condensing furnace. The condensation takes place in the third heat exchanger, which is manufactured out of stainless steel. This third heat exchanger extracts the last bit of practical, usable heat, and the resulting condensate is automatically piped into the drain.

NO COMBUSTION NOISE

Unlike the muffled sounds of pulse combustion or power burners, the only thing you'll hear is the gentle whirr of fan motors. Megasave I goes about its business quietly and efficiently.



ENERGY SAVING FEATURES

A superior primary and secondary heat exchanger.

The tertiary heat exchanger extracts the maximum usable heat and condenses much of the water vapor from the flue gases.

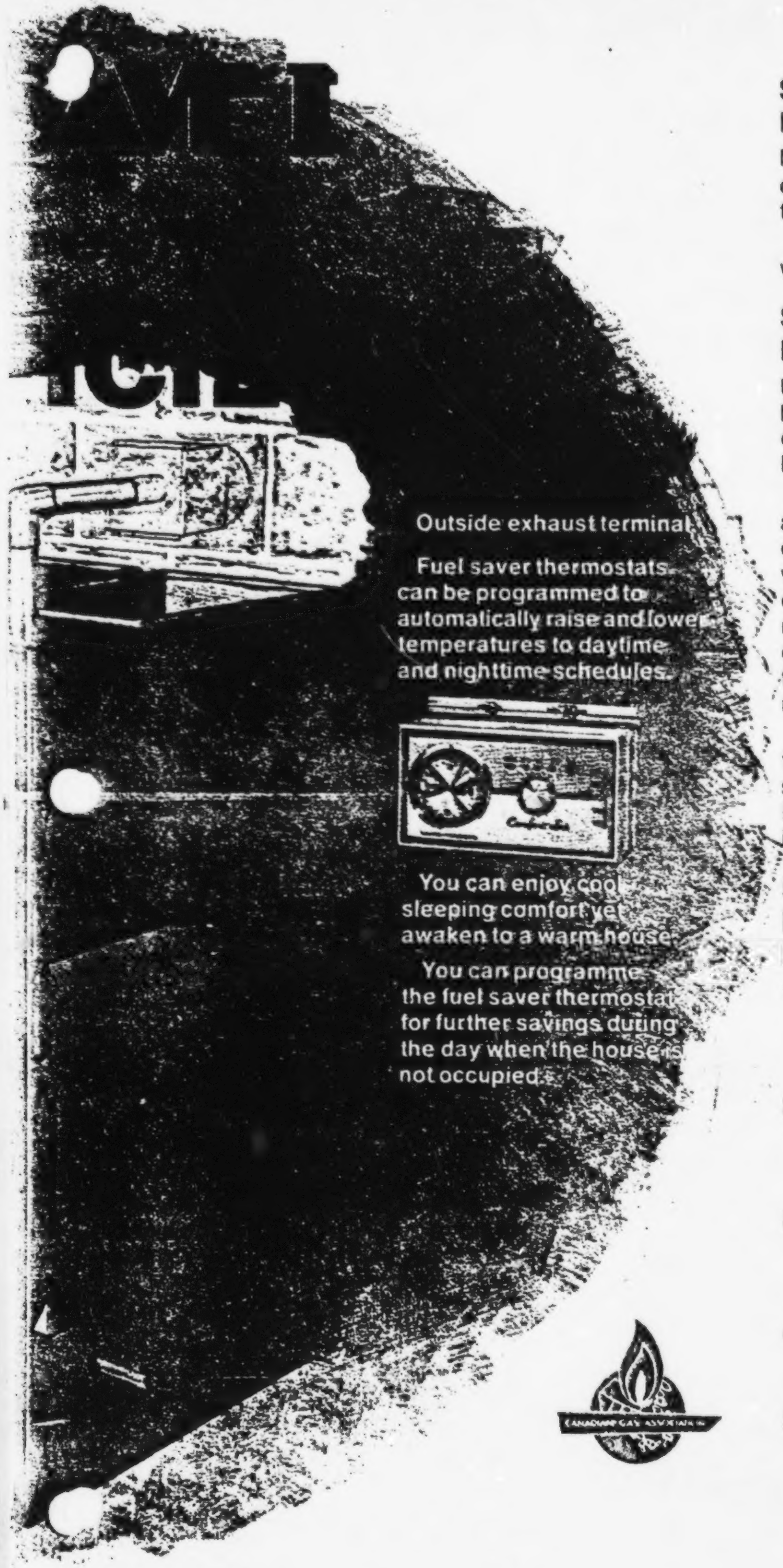
Exhaust fan removes cooled flue gases to the outside through a 2" plastic pipe.

Energy saving electric ignition. The pilot is on only when the main gas burner is operating.

Condensate is piped to the drain.

Save up to 47% over con

ventional oil furnaces.



Outside exhaust terminal

Fuel saver thermostats can be programmed to automatically raise and lower temperatures to daytime and nighttime schedules.

You can enjoy cool sleeping comfort yet awaken to a warm house.

You can programme the fuel saver thermostat for further savings during the day when the house is not occupied.

SIMPLICITY OF DESIGN ASSURES DEPENDABILITY

Megasave I is the product of years of research and development. The design is inherently simple and, therefore, practical and durable.

Megasave I has been designed to be easily serviced with standard furnace replacement parts.

SEASONAL EFFICIENCY ALMOST IDENTICAL TO LABORATORY EFFICIENCY

Under laboratory conditions, conventional furnaces have an efficiency rating of 75-80%. In actual use, over the entire heating season the efficiency drops to between 50% and 60%.

These lower efficiencies of conventional furnaces are the result of several factors, chief of which is the constant heat loss up the chimney. Even when a conventional furnace is not operating, warm basement air continuously escapes up the chimney. When the furnace is operating, the volume of basement air being drawn up the chimney increases dramatically. In addition, at the end of the operating cycle, much of the residual heat in the furnace goes up the chimney.

Conventional furnaces do not reach top efficiency for several minutes from the start of operation. During spring and fall, the short burning cycles are inefficient. Further energy losses in conventional furnaces are incurred by constantly burning pilots.

5 REASONS WHY THE MEGASAVE I IS AS EFFICIENT IN YOUR HOME AS IT IS IN THE LABORATORY

1. When the furnace is "Off", no warm basement air drifts up the chimney. **There is no chimney.** There is just an exhaust fan which operates when the furnace is on.
2. When the furnace is "On", the exhaust fan is operating, exhausting only sufficient flue gases to provide efficient combustion. No additional warm air is drawn from the basement.
3. At the end of the operating cycle, the exhaust fan is "Off", and the furnace blower clears the residual furnace heat through the duct work system into the house.
4. Megasave I reaches peak operating efficiency almost immediately. Mild weather inefficiency is eliminated.
5. The ordinary constant pilot is replaced by an electric ignition system. The pilot is "On" only when the main burner is operating.

ventional gas furnaces.

Condensation... proof of high efficiency

Until the advent of the condensing furnace pioneered by Clare, the efficient extraction of heat from combustion gases in forced air furnaces had to stop well short of the condensation achieved by Clare. Lowering the flue gas temperature much below 450°F (232°C) had two serious drawbacks. The most serious is the potential damage from condensation in the furnace – the second is chimney damage.

High temperature flue gas keeps the moisture inherent in the combustion process from condensing. The moisture is carried off through the chimney as a vapor and ultimately condenses in the air. Lowering flue gas temperature in a conventional furnace brings about cold spots on the heat exchanger which, in turn, cause condensation and damage to the furnace.

Megasave I is designed to condense flue gases; it is the only true high efficiency forced air furnace. The flue gas temperature is only approximately 112°F (44°C), which is the absolute proof that every bit of practical, usable heat has been extracted.

Megasave I is connected to the drain; the condensate is automatically carried away similar to condensate from a central air conditioning unit.

MEGASAVE I

Insurance against escalating fuel costs

Megasave I offers substantial savings today. Ever increasing energy costs will make today's savings even more significant in the future. Megasave I is your insurance to affordable home comfort for your family for years to come.

Clare

A truly Canadian company founded in 1854. Manufacturers of a complete line of heating and air conditioning equipment.

Clare research and development engineers are constantly at work. The Megasave I, with its substantial benefits to the homeowner, is an example of the dedication to quality and performance which is a hallmark of Clare.

You can always count on the Clare factory warranty. Generations of homeowners have relied on the lasting quality of Clare heating and air conditioning equipment.

AVAILABLE FROM:

**Savings are based on a seasonal efficiency of 55% of a conventional gas furnace without manual or automatic thermostat set-backs, and the employment of Megasave I with the dual set-back thermostat supplied. (Recent studies have indicated that seasonal efficiencies of conventional gas furnaces range from 50% to 60%.) Set-back calculations are based on 9°F (5°C) set-backs, i.e. 70°-61°F (21°-16°C) 10 p.m. to 6 a.m. and 8 a.m. to 4 p.m. seven days per week. Oil savings are based on a conventional oil furnace with a standard oil burner and fuel oil at $1.05 per gallon. Natural gas costs are based on rate schedules as of March 1981. Actual savings may vary, depending on the seasonal efficiency of your present furnace, geographic location, the use of a gas water heater with a chimney, and prevailing fuel costs.*

Clare Brothers Limited
223 King Street, Cambridge, Ontario N3H 4T5

P 2002

NEW PRODUCT INFORMATION

SUBJECT: Inter-City High Efficiency (Condensing) Gas Furnace

The new high efficiency gas, forced warm air condensing furnace by Inter-City will be available to the public as soon as final C.G.A. approvals are obtained and major production commences in about Sept. 1981. The furnace will be distributed in B.C. by Inter-City Gas Corporation at 3181 Thunderbird Crescent (Lake City Industrial Park) Burnaby, B.C. Phone 939-8361

Furnace details are as follows:

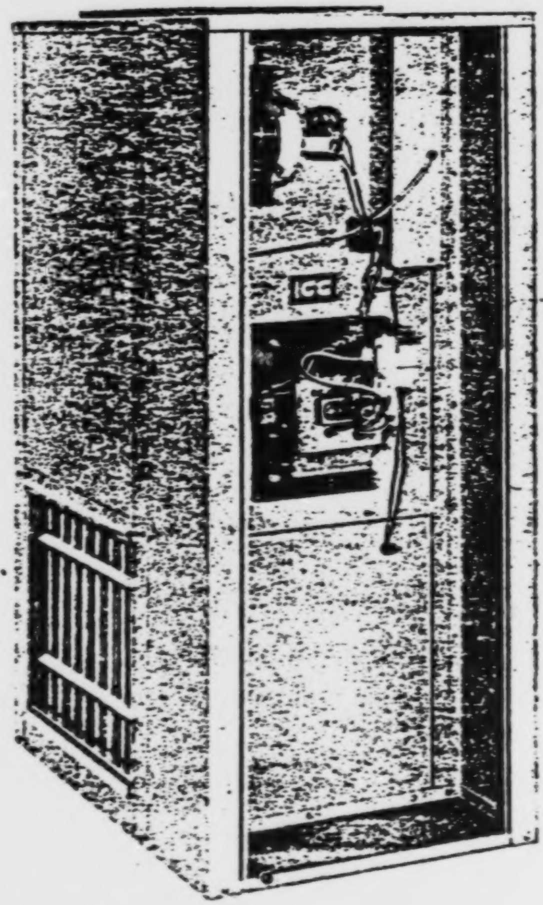
Claimed Combustion Efficiency	95%
Shipping Weight	Approximately 480 lbs.
Heat Exchangers	Drum type with a secondary built around this and a tertiary (a stainless steel finned tube coil) in a separate section of the furnace.
Flue Gas Temperature	Approximately 450^{0}F after the secondary exchanger. Less than 120^{0}F after the tertiary exchanger.
Venting	A forced-draft fan exhausts flue gases through 1½" PVC pipe sloping to return condensate to the furnace. Up to 60 equivalent feet of pipe may be used. Exhaust is normally through the wall with a special cover plate to minimize the effect of the wind.
Condensate Drain	Plastic hose with a trap is used to conduct condensate to a drain. The condensate was claimed to have a pH of 4.5 to 6.5.
Operation	A call for heat causes the forced draft fan to operate for a 40 second purge. A pressure switch detects flue blockage or fan failure. After the purge a White-Rogers spark ignition lights the pilot. The pilot then operates the main gas valve (after approx. 45 seconds). After shutting down, the system is purged again.
Installation	The furnace should be easy to install and eliminates the need for a class B vent unless required for a water heater.
Cost	Approximately $2,500. Installed systems cost could be in the $3,000 range.
Approvals	The furnace is in for C.G.A. approvals now, and Inter-City hopes for final approvals by September 1981.

Preliminary advance data for internal information only.

1981 June: WGB
Energy Use Engineering Department

Energy Conservation Division
B. C. Hydro

Gas Fired Hi-Efficiency Forced Air Furnace



THREE

HEAT EXCHANGERS

(TWO HEAVY GAUGE STEEL SECTIONS AND ONE STAINLESS STEEL MULTITUBE CONDENSING SECTION)

CONNECTED TOGETHER IN ONE CABINET

UP TO 95%

EFFICIENT

IN CONVERTING GAS INTO USABLE HEAT

! NO CHIMNEY !

! AUTOMATIC IGNITION !

PRINTED IN CANADA

— *THE FEATURES* —

1. Designed to provide years of economical, safe and dependable service.
2. Designed to reduce annual heating costs substantially—a sound investment—a major contributor to energy conservation.
3. Furnace incorporates "off-the-shelf" mechanical components allowing reliable replacement, if ever required. All components have been in use on residential and commercial heating appliances for many years.
4. The three heat exchanger system incorporated in the furnace makes use of most all the heat generated with exhaust gases being in the 80° to 120°F range (conventional gas furnace exhaust gas temperatures range from 450 to 500°F). These exceptionally low temperatures allow the use of a 1½" vent pipe that exhausts the gases through the nearest outside wall, therefore eliminating the need for the conventional chimney.
5. The furnace gas burner incorporates electronic ignition which not only provides excellent automatic gas ignition, but will reduce annual fuel costs by a further **5-7%** by the elimination of the conventional continuous burning pilot.
6. The inducer fan, which is an integral component of the furnace total operation also acts as a vent damper thus preventing the loss of conditioned air during the off-cycle periods. Containing the heat in this manner reduces annual heating costs by a further **13-15%.**
7. The large air capacity furnace blower with its three speed selection direct driven motor provides quiet movement of conditioned air at all times. Automatic continuous blower hi-low speed an optional extra.
8. All furnaces are factory pre-wired, fire tested and operated before packaging.

— *THE $AVING$* —

IN COMPARISON TO A CONVENTIONAL GAS FURNACE THIS UNIQUE HI-EFFICIENT FURNACE OFFERS TOTAL POTENTIAL ANNUAL ENERGY SAVINGS OF **36 to 42%.**

THESE SAVINGS ARE DERIVED FROM:

(a)	Higher steady state (combustion) efficiency plus heat reclaim from the gas water vapor.	18-20%
(b)	Electric intermittent ignition in place of the conventional continuous operating pilot.	5-7%
(c)	Control of flue loss — no chimney to continually exhaust heated indoor air.	13-15%
	Total % Saving	**36-42%**

— *Additional Energy Savings* —

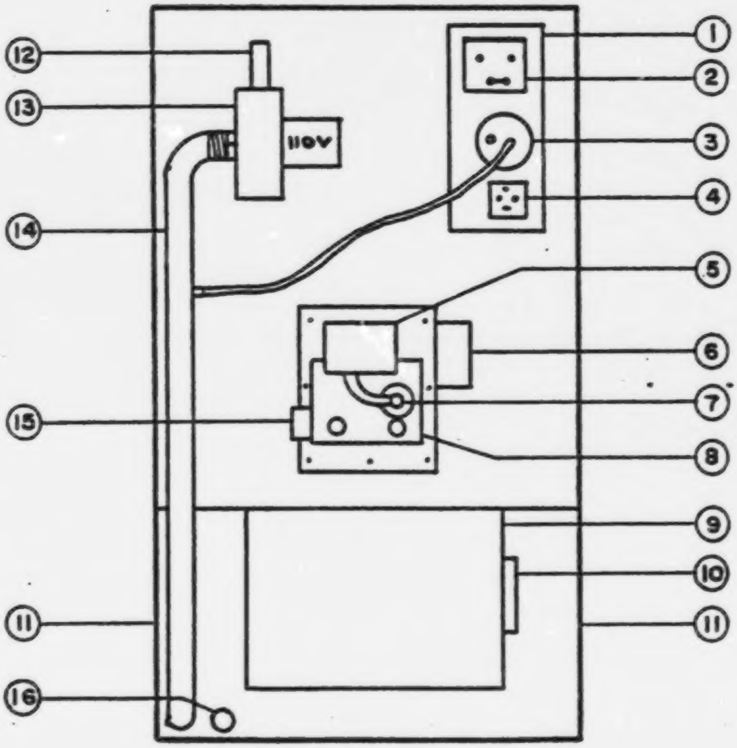
Turning the room thermostat down overnight will further reduce annual fuel consumption by 1% for each °F below the normal setting of 70°F. Thus a 10°F reduction will **add a further 10% saving** to that shown above.

The thermostat may be the manually adjusted type or an ICG CHRONOTHERM set back type that adjusts the temperature setting AUTOMATICALLY every day throughout the full heating season.

— SPECIFICATIONS —

B.T.U. Input — 60,000 to 100,000 B.T.U./h
B.T.U. Output — 57,000 to 95,000 B.T.U./h max.
Air Volume — 650 to 1,000 C.F.M.
Temperature Rise — 85°F
External Static Pressure — .25" W.C.
Blower Motor H.P. — ¼ — 110V, 60 Hz, 1 ph. — 3 speed — direct drive
Heat Exchanger Metal (2) — 14 & 16 gauge
Condensing Section Metal — Stainless steel No. 304, 18 gauge
Control System — 24 volt
Gas Valve — (a) Amperage rating — .6 (b) Size — ½"
Inducer Fan Amperage Rating — 1.6
Room Thermostat Anticipator Setting — .8 amp. Minimum
Vent — (a) Size — 1½" (b) Const. Type — PVC
Cabinet Dimensions: 26" wide x 60" high x 35¾" deep
Warm Air Plenum Connection Size: 17¾" x 17¾"
Shipping Weight — 480 Lbs.

— CONSTRUCTION DETAIL —



1. Electrical junction box
2. Comb. Fan & Limit control — Honeywell L4064-5" insert.
3. Air pressure switch
4. Relay — R8022-1000 B
5. Electric Gas valve
6. Electric ignition module
7. Adj. burner orifice
8. Atmospheric upshot single port gas burner
9. Furnace blower
10. Blower motor — direct drive
11. Return air inlet — L.H. (or R.H. optional)
12. 1½" vent pipe connection
13. Inducer fan
14. 2" PVC vent pipe
15. Pre-purge/post purge control
16. Condensate drain

— *FURNACE OPERATING SEQUENCE* —

START

1. Room thermostat calls for heat.
2. Vent inducer fan is energized through relay switch.
3. In approximately ten seconds (time required for inducer fan to establish draft through furnace and create a .8" W.C. negative operating pressure) the air pressure switch contacts will close and energize the pre-purge switch.
4. In approximately forty seconds the pre-purge switch will energize the gas electric ignition system.
5. Pilot ignition is established.
6. In approximately thirty seconds the gas valve will open and the gas burner will be in operation.

STOP

1. Room thermostat is satisfied and shuts off electric power to gas valve.
2. Gas to burner and burner pilot off.
3. Inducer fan starts to slow down purging unit of products of combustion. In approximately fifteen seconds fan will stop.
4. As inducer fan is gradually coming to a full stop the internal negative operating pressure is changed and will open the air pressure switch contacts, shutting off all power to the furnace control system.

Note: Furnace blower operation the same as a conventional gas furnace.

— *NOTE* —

ALL STATEMENTS MADE IN THIS PUBLICATION ARE DERIVED FROM ACTUAL ICG LABORATORY TESTS AND ARE SUBJECT TO REVISION BASED ON FINAL CANADIAN GAS ASSOCIATION TESTS AND CERTIFICATION.

NEW PRODUCT INFORMATION

SUBJECT: Amana High Efficiency Residential Heating Unit

This new package provides the space heating as well as domestic water heating and consists of three basic components:

1. outdoor unit where all combustion takes place;
2. the indoor blower coil unit that supplies warm air for heating the house;
3. optional domestic water heater of double wall construction.

All combustion takes place in the outdoor section which means no gas vent or combustion air is required in the house. Only two glycol circulation pipes interconnect the indoor and outdoor components.

The manufacturer claims 81.5 - 83.1% annual fuel utilization efficiency. The unit is designed to operate on natural gas but with minor field adjustment propane can be used. Electronic ignition is a standard feature.

Heat Exchanger:	The heart of the heating unit is the Heat Transfer Module (HTM) which is about the size of a 3 lb coffee can. It consists of a cylindrical burner with approximately 20,000 perforations and an annular liquid filled heat exchanger. Heat is transferred from the burner to the circulating 50% distilled water and 50% glycol solution through the pipes embedded in steel fins of the heat exchanger surrounding the burner. The solution is circulated through the indoor coil and when coil temperature reaches 51°C (124°F) the blower automatically starts to deliver warm air to the structure. In installations where water is also heated by the outdoor unit, a diverting valve in the blower coil unit routes the hot solution to the water heater on demand for hot water.
Fluid Check:	The circulating glycol/distilled water should be checked annually in the fall to ensure the freeze protection properties of the fluid are adequate for the local climatic conditions and that PH of the solution ranges between 7 to 9.5 for corrosion protection.
Heating Capacity:	The outdoor unit is factory set to operate on 29.3 kW (100,000 Btuh) on natural gas but can be converted to 23.4 or 35.2 kW (80,000 or 120,000 Btuh) input on natural gas or propane using the orifice plates supplied with the unit.

Approvals: The entire package carries CGA approval and has ARI certification.

Cost: The installed cost with the water heater is $4,000 to $4,700 and $3,000 to $3,700 without the water heater depending on house configuration. The trade price of outdoor unit and the blower coil unit is approximately $2,200 and that of the double wall water heater is approximately $800.

Availability: Werner's Refrigeration located at 2555 Eastbrook Parkway, Burnaby (telephone: 291-7788) market the Amana heating units.

Preliminary advance data.

October 1982: MSG
Energy Use Engineering Department

Energy Conservation Division
B. C. Hydro

JDS14.7

Amana® HTM PLUS™ HEAT 'N HOT WATER SYSTEM

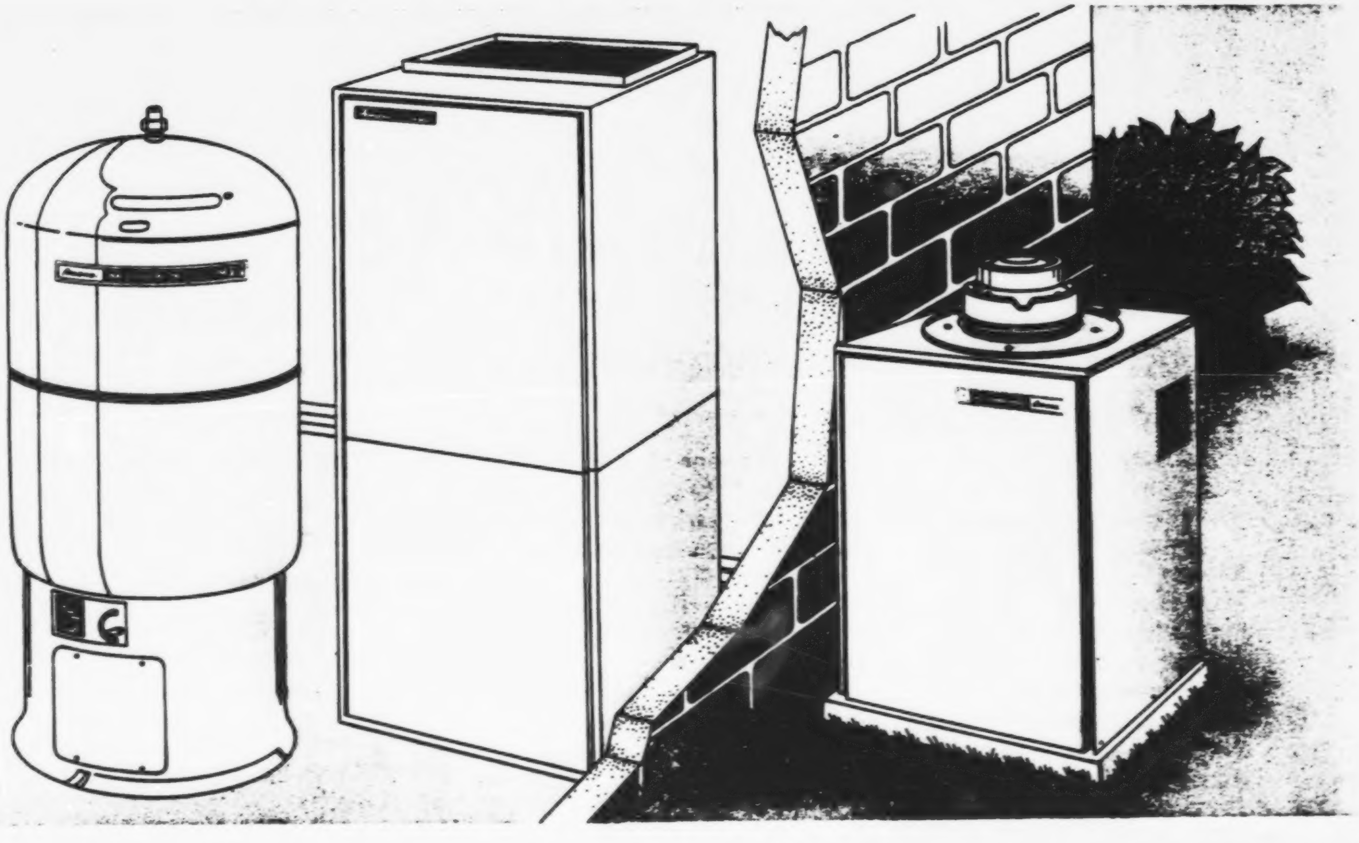
A complete, energy saving system that heats your home efficiently and provides a virtually unlimited supply of hot water with the optional high efficiency water heater.

Three specially matched components. The Amana Heat 'n Hot Water System consists of three separate components that are specially designed and matched to form a total, energy saving home comfort system: A compact outdoor unit contains the exclusive Amana Heat Transfer Module (HTM®), where all combustion takes place; an indoor blower-coil that heats indoor air; and an optional water heater.

Easy to install, no chimney or flue required. All combustion takes place in the outdoor unit, so no flue or chimney is required. That saves money on new construction costs and allows you to reduce heat loss by sealing off existing chimneys. The outdoor unit can be located as needed to eliminate long gas lines. The indoor blower-coil unit can be installed in any position to fit your needs. The water heater requires only piping and electrical connections.

Capacities to fit your comfort needs. Heating capacities are 80,000, 100,000 or 120,000 BTUH input on natural or propane gas fuels. Your Amana dealer will select the right size to meet your heating requirements.

Add-on cooling. You can easily add central cooling to your system. Amana makes an air conditioning system that's right for your home or building.



IT HEATS YOUR WATER
A VIRTUALLY UNLIMITED SUPPLY OF HOT WATER!

The Amana HTM Plus Water Heater is a revolutionary new concept in water heating. It provides a virtually unlimited supply of hot water. You can wash clothes, take a shower, and run the dishwasher all at the same time without running out of hot water!

It doesn't look like ordinary water heaters because it doesn't work like other water heaters:

High capacity, small tank. Water heaters are ranked by their "first hour rating." That is the amount of water that can be withdrawn in an hour in a temperature range between 140°F and 160°F, or heated approximately 90°. The compact Amana 40 gallon water heater has a first hour rating of up to 143 gallons per hour. That's more than most 75 or 100 gallon water heaters.

Heats water faster. The Amana Water Heater has a heating input of up to 120,000 BTUH. Conventional 40 gallon water heaters have about 40,000 to 50,000 BTUH heating input. This higher heating input provides much faster water heating, giving you enough hot water to meet all your needs.

Water stays hot longer. The Amana HTM Plus Water Heater has a very low standby heat loss. Standing with a full tank of heated water, it loses about 1°F per hour. That compares to 5-10°F per hour for competitive gas water heaters. So your water stays hot longer.

Low heat loss means important savings for you. During the night, while you sleep, a conventional water heater will cycle on just to maintain the water temperature. If a 20° heat loss is required to activate the water heater, a unit that loses 5-10° per hour will cycle on 2 to 4 times overnight. The Amana water heater, losing about 1° per hour, will not cycle on at all.

Over a 10 year period, a water heater with a loss of 5° per hour will cycle on about 7,300 times more than the Amana system. A water heater with a loss of 10° per hour will cycle on about 14,500 times more. These needless cycles are all to maintain water temperature because of overnight heat loss.

Since every cycle consumes expensive energy, the Amana HTM Plus Water Heater can give you important savings compared to standard water heaters.

IT HEATS YOUR HOME
WITH SAVINGS OF 15% TO 23%

A revolutionary new concept in heating, the Amana HTM Plus™ Heat 'n Hot Water System heats your home and your water.

It can save 15% to 23% on space heating costs compared to a standard Amana upflow gas furnace.* That's because the HTM Plus System incorporates the exclusive Amana Heat Transfer Module (HTM®), a major breakthrough in gas heating technology. It replaces the bulky conventional heat exchanger found in most furnaces with a highly efficient combustion chamber small enough to hold in your hands.

It has an abundant heating capability with high Annual Fuel Utilization Efficiences (A.F.U.E.s) of over 80%. You get heating comfort while enjoying significant savings on your heating bills.

For example:
In Chicago, if natural gas is 40¢/therm and your home loses 50,000 BTUH/hour, typical costs for operating a 120,000 BTUH input furnace would be as follows:*

Typical Energy Savings

Amana HTM Plus System
$499 per year

Amana Standing Pilot Furnace
$620 per year

Savings
$121 per year

The savings for the same home using 60¢/gallon propane is $216/year!

---

*Energy costs and savings based on DOE test procedures.

NEW PRODUCT INFORMATION

SUBJECT: Arkla Recuperative Furnace
(High Efficiency Condensing Furnace)

Arkla, known for many years in Canada as suppliers of barbeques and gas post lamps, have now introduced their high efficiency model condensing furnace to Canada. It is designed specifically to accommodate split system air conditioning from 3.5 to 4 tons. It is approved for either vertical or horizontal venting through a stainless steel three and a half-inch vent.

Claimed Combustion Efficiency - 88%

Sizes

Small models - 50-70,000 Btu/hr input 18" x 28" x 48½"
Larger models - 85 & 105,000 Btu/hr input 24" x 28" x 48½"

Heat Exchangers

The primary heat exchangers are conventional clam shell (gas furnace type). The condensing section heat exchanger is a closed bottom, stainless steel secondary heat exchanger in which flue gas temperatures are lowered below the dew point and condensation occurs. Maximum flue temperatures into the vent are 215°F.

Condensation Drain

This is drained from the bottom of the condensing section by a half-inch plastic pipe. There is an additional plastic pipe higher up on the exchanger to ensure reliable operation even if the bottom outlet becomes plugged.

Operation

A call for heat starts the spark ignition pilot light and induced draft fan. When the pilot is proven the main burner lights. Main furnace fan comes on when there is sufficient heat for distribution. The main fan is a four speed direct drive fan - fixed to operate at one speed only (selectable through rewiring). An air conditioning relay is included to provide high speed operation when wired into an add-on air conditioning system.

Installation

The furnace is of normal size for an upright gas furnace and so should not present any physical problems for installation. A drain connection or sump pump arrangement must be used to drain off the slightly acidic condensate. Venting can be horizontal, but must slope upward at least ¼" to the foot on the 3½" stainless steel vent stack. The joints must be sealed with special caulking to prevent condensate dripping out. Normal vertical venting is permitted with the stainless steel vent, however, a number of venting details for running inside old chimneys or vents or co-venting of water heaters will have to be resolved with Provincial Gas Inspection.

Distributor

Inesko Equipment Ltd.
#201 - 2160 Springer Avenue
Burnaby, B. C.
V5B 3M7

Attention: Mr. Bruce Murrey

Telephone: (604) 299-6291

Cost

It is estimated to cost about $2,800 to $3,200 installed, replacing an existing furnace.

New Home Installations

With full ductwork, cost would average from $4,000 to $4,600 not including a water heater.

Approvals

CGA approved.

Preliminary advance data only.

October 1982: WGB
Energy Use Engineering Department

Energy Conservation Division
B. C. Hydro

JDS14.5

procedures.

Arkla's Recuperative Heating System can cut your heating bills by as much as 66%.

66%. It's incredible, but true.

That's because the Arkla Recuperative Heating System is revolutionary. It's the most economical heating system available today. Virtually no other brand of heating even comes close. Not Rheem, York, Bryant, General Electric, Payne; no one.

Take a look at the following chart. You'll see how you can set yourself free from inefficient heating systems and skyrocketing energy costs.

	You could save this much next year:	This much in 3 years:	This much in 5 years:	% savings:
If you're using all-electric heat...	$798	$2,693	$4,943	66%
...an all-electric heat pump...	$348	$1,173	$2,091	44%
...an old gas furnace...	$154	$ 522	$1,036	31%
...an "add-on" heat pump...	$150	$ 506	$ 855	23%

(Based on average energy consumption data of selected northern U.S. regions and on the U.S. Department of Energy national average energy cost.)

Now that you've seen proof of Arkla's cost efficient performance, see your Arkla dealer. Using a special heat savings calculator, he'll show you how to determine the amount of heat you've been losing and how you can save heat with an Arkla Recuperative Heating System. He'll tell you how to keep the heat you're paying for with your hard-earned dollars.

Arkla Recuperative.
The heating system that can pay for itself in little more than two years.

A patented recuperative stainless steel cell. That's what makes the Arkla Recuperative Heating System so revolutionary, so unique, and so efficient. Arkla's Recuperative actually wrings more heat from the fuel you're paying for. If you're using all-electric heat now, Arkla's system could pay for itself in little more than two years.

Arkla frees you from skyrocketing electric heating costs without even having to pay for a chimney.

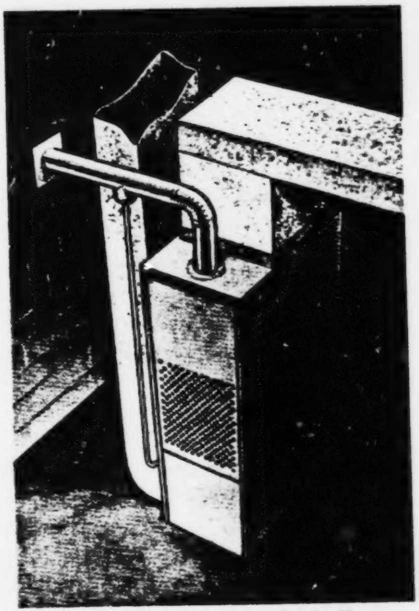
The Arkla Recuperative Heating System not only lets you replace expensive all-electric heat with economical gas heating, it lets you replace it with the most efficient gas heating system ever devised. No more dreading painful monthly heating bills. No more paying for heat that goes up the chimney to heat the neighborhood.

And since this patented Arkla system can be vented through a side wall as easily and simply as a clothes dryer, you won't have to worry about having a chimney installed. So, you don't even have to dread expensive chimney installation costs.

The Arkla Recuperative Heating System looks like and installs like a conventional furnace.

Arkla's Recuperative uses the very same components most modern gas furnaces have, such as an energy-saving intermittent spark ignition. Even the controls you need are pre-wired to match your air conditioning. Then Arkla adds the patented technology of a recuperative stainless steel cell, to wring more of the heat you pay for from the fuel that's burned.

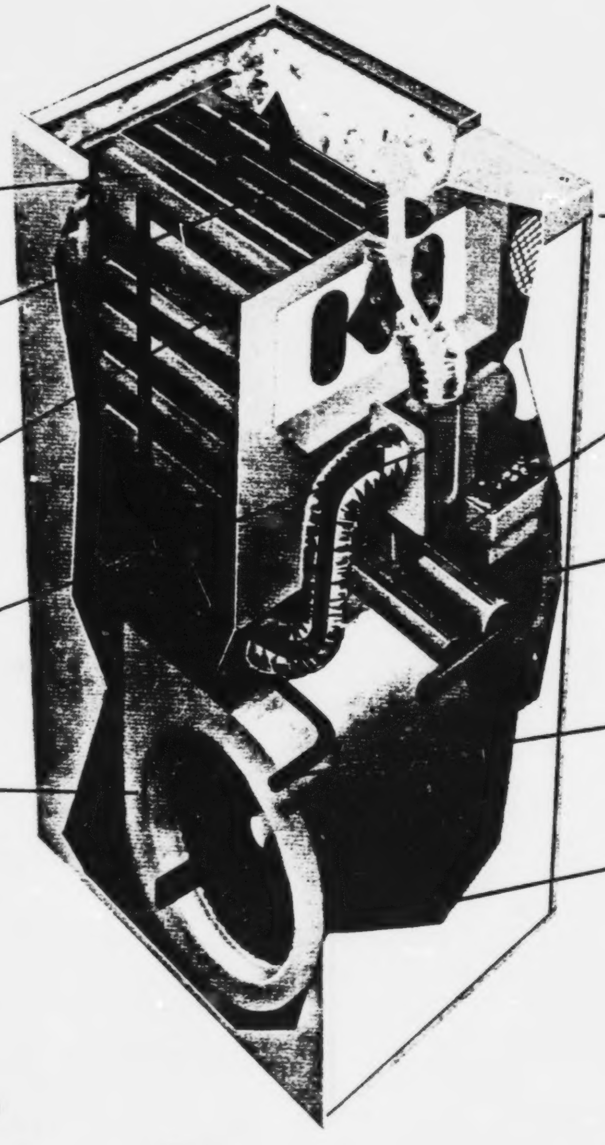
Because of Arkla's unsurpassed efficiency, the Recuperative Heating System gives you a lot more heat than a conventional gas furnace with the exact same rating. There's never a problem replacing a conventional gas warm air furnace with an Arkla Recuperative, because Arkla fits right in. You don't have to worry about reworking your heating system to accommodate an Arkla either.



After Arkla pays for itself, it keeps on paying you.

Having a patented Arkla Recuperative Heating System is just like having an investment in your home. After its initial payback period, it keeps on paying you for the life of the system. It even comes with a limited 20-year warranty. That's right, 20 years!

The Arkla Recuperative Heating System keeps the heat you pay for.



Patented stainless-steel recuperative cell wrings out more of the heat you pay for.

Primary heat exchanger is made of heavy-duty aluminized steel to last for years. It's virtually service free.

Venting is so cool it can be piped through a side wall, like the vent of a clothes dryer.

Power vent actually pulls hot combustion air through recuperative cell and vents exhaust outside.

Big multispeed blower quietly moves heat all over your home. It has capacity to handle air conditioning, too.

Heavy steel "wrap-around" cabinet doesn't "pop" or "ping" as it heats—and it keeps looking good for years.

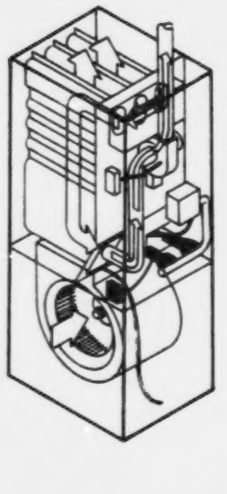
Intermittent spark ignition starts, and starts quietly, every time. Never wastes gas.

Proven time and again, the patented single port burners are maintenance free. So, they'll burn quietly and efficiently for the life of the system.

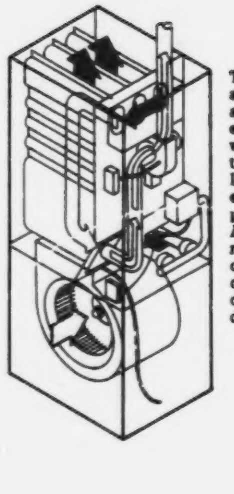
Condensation drains off, just like condensation from a central air conditioner or humidifier.

Special permanent air filter doesn't need replacement. You just rinse or vacuum it clean.

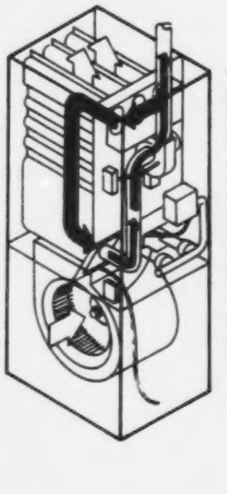
Patented Recuperative Cycle



When your thermostat tells the Arkla Recuperative Heating System to start up, the gas turns on and is lighted by a cost-saving and energy-saving electronic spark igniter.



The heated combustion air goes up through aluminized steel heat exchangers, where it warms the air going to the rooms in your home. It then exits the heat exchangers at a temperature of 400°F-550°F. At this point, any ordinary furnace sends the combustion air up your chimney—wasting lots of extra heat and extra dollars.



Your Arkla Recuperative Heating System wrings out that extra heat! A power vent fan pulls the combustion air through an extra step—down through another heat exchanger—a special patented stainless-steel counterflow recuperative cell. This captures and saves more of the heat that's available, and the final exit temperature is as low as 150°F. Arkla keeps the heat you pay for better, more efficiently, and more economically than virtually anyone else.

P 2009

NEW PRODUCT INFORMATION

SUBJECT: Duomatic/Olsen Condensing Furnace (Ultramax)

A new introduction to the high efficiency condensing furnaces is the Duomatic/Olsen Ultramax. The unit employs the new Honeywell V8440 redundant (double safety feature) gas valve with electronic ignition and 30 second built-in pre-purge. This combination gas valve simplifies wiring and servicing of the unit.

Claimed Combustion Efficiency - 95%.

Sizes:	60,000, 70,000, 80,000 and 90,000 Btu/hr input.
Cabinet Size:	20-1/4" W x 29-3/4" D x 52" H for all models.
Heat Exchangers:	The primary heat exchangers may vary in number and are conventional clam shell (gas furnace type). The secondary heat exchanger is a stainless steel closed up clam shell in parallel with the primary heat exchangers. The tertiary condensing heat exchanger is a stainless steel fin tube mounted horizontally at the bottom - just above the fan. It is in the tertiary heat exchanger that the flue gas temperatures are lowered below the dew point and condensation occurs. Flue temperatures are in the order of 100°F (39°C).
Condensate Drain & Venting:	Condensate is drained from the third heat exchanger and the fan housing, neutralized of its acidic content - then run to a floor drain through a small plastic pipe. Venting is via a 2" plastic ABS pipe and the unit can be vented horizontally through the wall.
Operation:	A call for heat starts the induced draft fan and spark ignition pilot light. After a 30 second pre-purge and pilot is proven the main burner lights. Main fan comes on when there is sufficient temperature for distribution. Fan is a standard belt drive which slides out for service.

Installation: The furnace is normal size for a standard upright gas furnace for ease of installation. A drain or a miniature sump pump must be used to drain off the neutralized condensate (possibly up to 2.5 gals per day). Venting can be horizontal with 2" ABS plastic but must be sloped back to the furnace at least ¼" to the foot to allow condensate to drain back to the unit.

Distributor:

Century Sales and Controls Ltd.
2300 Madison Avenue
Burnaby, B. C.
V5C 4Z1

Attention: Murray Marley

299-1248 or 112 800 663-3193.

Cost: It is estimated that to install a replacement furnace would cost about $2,800 to $3,000.

With full ductwork, cost would average $4,000 to $4,500 not including a water heater.

Approvals: CGA approved.

Preliminary advance data.

February 1983: WGB
Energy Use Engineering Department

Energy Conservation Division
B. C. Hydro

JDS17.1

The Technology of
extracts
more heat from
every energy dollar!

High-Efficiency Gas Furnaces by:

DUOMATIC
OLSEN

Delivers 95% Efficiency

CONVENTIONAL FURNACES

THE ADVANCED ULTRAMAX DESIGN

INSTALL WITH EASE

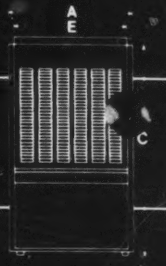
SERVICE WITH A SMILE

The Features and Benefits of Ultramax

ULTRAMAX

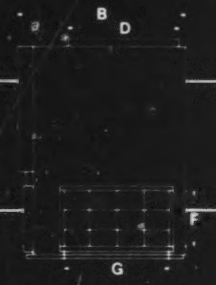
MODEL	C.G.A. RATING, BTU/HR				AIR VOL C.F.M. @ 70°F T.R.	MAIN BLOWER W x D IN	INDUCED BLOWER W x D IN	EXTERNAL STATIC PRESSURE			
	0'-2000'		2000'-4500'					.25" W.C.		.50" W.C.	
	INPUT	OUTPUT	INPUT	OUTPUT				Pulleys	Motor H.P.	Pulleys	Motor H.P.
HCS 90 (H)	90,000	85,900	81,000	77,400	1,136	10-10	1 1/32 x 6 5/16	3¼ x 6	1/3	3¼ x 5	1/3
HCS 80 (H)	80,000	76,100	72,000	68,500	1,006	10-10	1 1/32 x 6 5/16	3¼ x 6	1/3	3¼ x 5	1/3
HCS 70 (H)	70,000	66,300	63,000	59,600	877	10-10	1 1/32 x 6 5/16	3¼ x 6	1/3	3¼ x 6	1/3
HCS 60 (H)	60,000	56,600	54,000	50,800	749	10-10	1 1/32 x 6 5/16	3¼ x 6	1/3	3¼ x 6	1/3

NOTE: TEMPERATURE RISE FOR UNIT APPROVED AT 55 - 85°F　　CFM SPECIFICATION BASED ON SEA LEVEL　　(H) - HIGH ALTITUDE MODEL



ULTRAMAX

MODEL	CABINET, IN			RETURN AIR FxG	WARM AIR DxE	VENT DIA IN	MAX. EQV. VENT LENGTH FT	AIR FILTER IN	GAS PIPE DIA IN	CLEARANCE, IN						SHIP W.T. LBS
	WIDTH	DEPTH	HEIGHT							TOP	FRONT	SIDE-1	SIDE-2	BACK	VENT	
	A	B	C													
HCS 90 (H)	20¼	29¾	52	14 x 22	18 x 19	2	60	16 x 25 x 1 (PERM.)	½	1	18	1	6	0	0	250
HCS 80 (H)	20¼	29¾	52	14 x 22	18 x 19	2	60	16 x 25 x 1 (PERM.)	½	1	18	1	6	0	0	250
HCS 70 (H)	20¼	29¾	52	14 x 22	18 x 19	2	60	16 x 25 x 1 (PERM.)	½	1	18	1	6	0	0	250
HCS 60 (H)	20¼	29¾	52	14 x 22	18 x 19	2	60	16 x 25 x 1 (PERM.)	½	1	18	1	6	0	0	250



NOTE: In the U.S.A. before purchasing this appliance, read important energy cost and efficiency information available from your retailer.

A new heating system is a major decision.... make it wisely, consider the advantages of...

DUOMATIC OLSEN

P.O. Box 900, Tilbury, Ontario, Canada N0P 2L0
Phone: (519) 682-2062　Telex: 064-78553

Duomatic/Olsen produces a complete line of gas, oil, electric, combination and solid fuel heating systems. For further information, contact your local distributor or contractor.

Sales Offices

United States
9342 Harrison Road
Romulus, Michigan 48174
Phone (313) 946-7880

British Columbia
13281 Comber Way
Surrey, B.C. V3W 5V8
Phone (604) 596-6221

Quebec
8200-8210 Avenue de l'Industrie
Ville d'Anjou, P.Q. H1J 1S7
Phone (514) 354-4896

AVAILABLE FROM:

NOTE: All specifications are subject to change without notice.

Printed in [illegible]

NEW PRODUCT INFORMATION

SUBJECT: Airco 8300 Turbo Furnace

Airco Products has announced the addition of a series of intermediate efficiency furnaces to their product line. These furnaces are their standard high boy model made more efficient by the addition of spark ignition and induced draft fan venting, replacing the gravity vent and draft diverter.

Furnace details are as follows:

Claimed Combustion Efficiency	83%.
Cabinet Size	Indentical cabinet as the standard models in the "High Boy" series.
Heat Exchangers	Clam shell heat exchangers, as in the conventional furnace.
Flue Gas Temperature	350°F to 400°F or about 150°F less than conventional furnace (before draft diverter).
Venting	This unit uses a small three inch vent (metal) and must be connected to a conventional "B" vent or chimney, sized in accordance to vent sizes required for the conventional furnace of the same input. Gravity vented water heaters can be co-vented to the same vent or flue, as is common practice for the conventional furnace.
Sizes Available	60,000 through 140,000 Btu/hr in "High Boy" models.
Operation	This furnace is a non-condensing model using White Rogers spark ignition. A call for heat, lights the pilot and starts the induced draft fan simultaneously. Main burner will light 45 to 90 seconds after the initial call for heat (characteristic of this gas valve). There is no pre-purge timer built in to existing models - but this may be added later.

Installation	Since the venting method is conventional and the cabinet size the same as existing "High Boy" Airco furnaces, installation should be straight forward. When replacing existing Airco "High Boy" furnaces, it should be possible to make the exchange without any ductwork adapters being required.
Cost	Installed costs as a furnace replacement should average about $1,850 to $2,200 (without ductwork). Ductwork costs on a new home appear to be averaging about $1,300 to $1,400 currently, so far a new home total installation should cost about $3,500.
Approvals	CGA tested and approved by Provincial Gas Inspection for installation in B. C.
Availability	The furnaces should be in production by September 1982 and be available from all Airco distributors in B. C.

Preliminary advance data.

October 1982: WB
Energy Use Engineering Department

Energy Conservation Division
B. C. Hydro

JDS14.2

AIRCO ...FIRST IN HOME HEATING

Airco High-Efficiency 8300 turbo

When we say our new 8300 gas furnace can save you money, we are not just talking a lot of hot air.

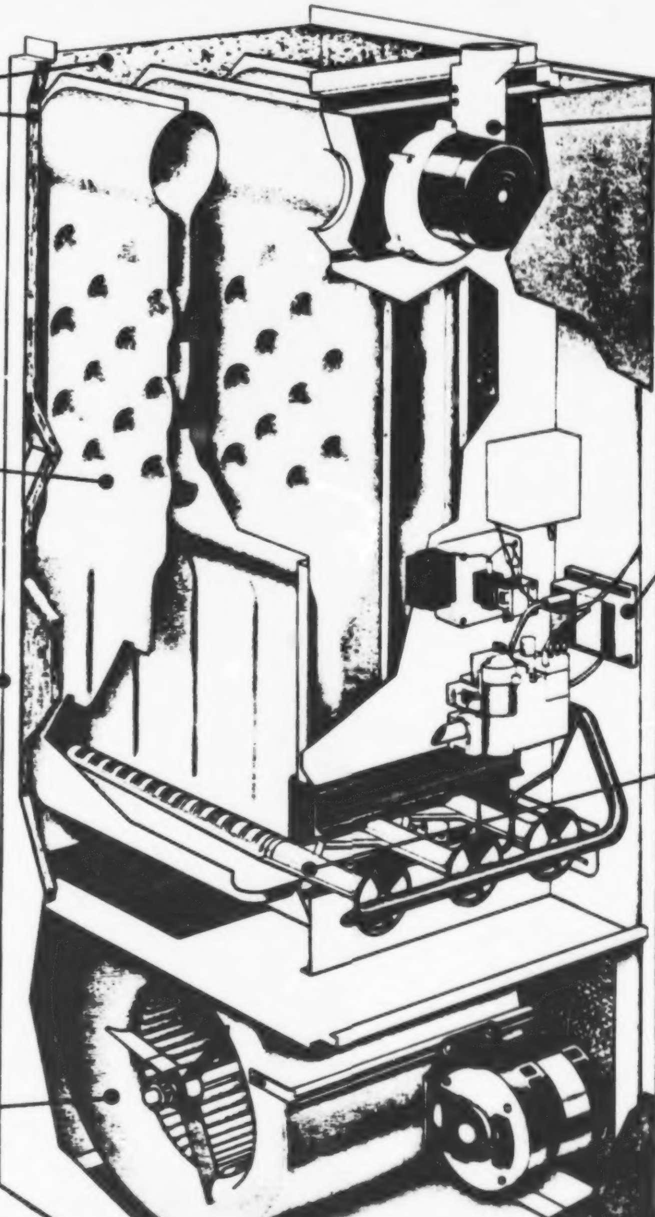
We compared our new 8300 furnace against the best conventional models and against high efficiency condensing furnaces. Either way the 8300 came out a clear winner.

The Airco 8300 High Efficiency furnace (averages 83% efficiency measured on the annual Fuel Utilization Efficiency Scale) will save you hundreds of dollars in fuel costs and is reasonably priced. This makes it the most cost effective gas furnace available.

Unlike some other high efficiency furnaces, the 8300 does not create the pollution disposal problem of acidic condensate.

The average home owner should save the extra cost of an 8300 over a conventional furnace in about two years with reduced fuel bills while it could take up to seven years to get your money back with an expensive condensing unit.*

**Ask your dealer for the Airco Furnace Efficiency Comparison Guide.*



FOIL BACKED INSULATION

The Airco 8300 is completely insulated with a sheath of foil-faced glass fibre insulation. This helps prevent heat loss and keeps the furnace cool to touch — even when it's operating. Structural members in the casing not only give the 8300 incredible strength and rigidity, but also act as interior baffles directing the airflow in a wiping action against the heat exchangers.

HEAT EXCHANGER

This is the heart of the 8300. Its unique shape and design are no accident. They swirl the hot flue gasses inside to give an even flow of heat to all parts of the heat exchanger. No hot spots mean better heat transfer and fuel economy.

QUALITY CONSTRUCTION

The casing on the 8300 is a heavier gauge steel than found in most furnaces. So is the steel used in the heat exchanger. The motor and blower modules are rubber-mounted for greater quietness. And the blower glides on rails for easy access and service. Patented burners, long life heat exchangers, beautiful baked enamel casing — the new 8300 is engineered with the same attention to detail that has made Airco the most popular furnace in the West for more than 30 years.

MODULAR MOTOR AND BLOWER

Rubber-mounted for whisper-quiet operation, the separate motor and blower modules are fully adjustable. So, each unit can be custom-fitted to suit the house it has to heat.

EXCLUSIVE TURBO VENT

This is the key to the greater efficiency of the 8300. It draws air into the combustion chamber in just the right quantity for perfect combustion. It keeps the hot flue gasses inside the heat exchanger longer so that more heat is taken into the home before the gasses are exhausted to the outside. The exclusive turbo vent also eliminates the loss of warm air up the chimney during the off cycle.

ELECTRONIC IGNITION

When the thermostat "calls for heat", the 8300's ignition system starts the gas flow and ignites the pilot electronically. This is not only the safest method, it's also very economical because there is no constantly burning pilot to waste gas.

BALANCED BURNER

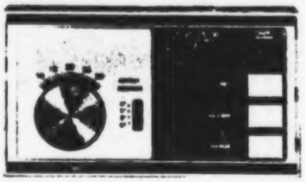
The 8300 turbo has the most sophisticated burner in the industry. Its special patented design mixes air with gas in perfect proportions. And its uniquely contoured shape provides constant, even heat with no "hot spots". Result? More heat from less fuel.

AUTHORIZED AIRCO DEALERS

Airco dealers are more than appliance salesmen. They're qualified installers. Knowledgeable of codes and regulations. Skilled in sheet metal. And licensed to handle gas. They know furnaces inside and out. And can advise you how to make every penny count when it comes to heating your home.

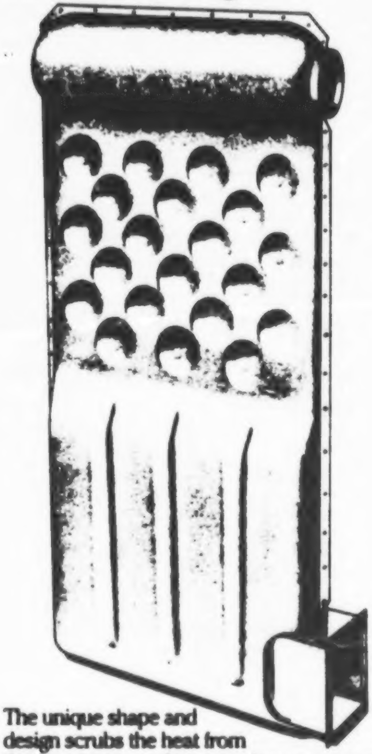
C.G.A. APPROVED

Fuel Saving Thermostat



You can program different temperature settings for different times of the day. You just set the program on the thermostat and the 8300 does the rest. When you get up in the morning, your home is nice and warm. When you're out at work or shopping, the furnace turns itself down. And just before you come home, it turns itself back on. So when you walk through the door, the house is pleasantly warm. At night while you are asleep, the 8300 turns itself down again, because you're cosy and snug in bed. The 8300 gives you the heat you want, when you want it. Automatically. And you can vary the temperatures, the times, and the changes — according to the weather. So you're only paying for heat you like. Not heat you don't need.

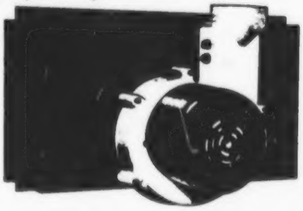
Airco High Efficiency Heat Exchanger



The unique shape and design scrubs the heat from the flue gasses so that a maximum amount of heat is extracted through the steel walls. The Airco design creates an even temperature over the entire heat exchanger surface giving the best possible heat transfer to the warm air wiping the outside surfaces of the heat exchanger. The heavier gauge steel, proven clam shell design, and several exclusive construction details have created the Airco High Efficiency heat exchanger's legendary reputation for long life.

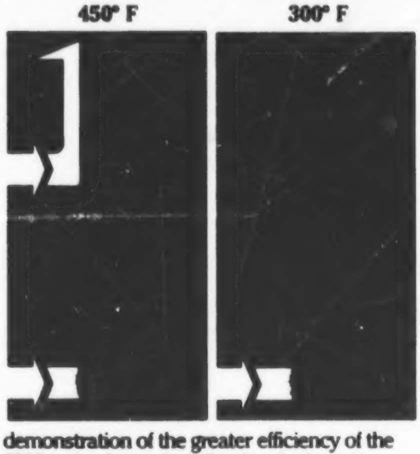
Airco's Ingenious Turbo Vent

Conventional gas furnaces are fitted with a draft diverter, which allows warm air to escape up the chimney with the hot flue gasses. Even when the furnace is off, warm air still escapes continuously through the chimney. The turbo vent on the new 8300 stops all this. The only thing that goes up the chimney now are the products of combustion. The turbo vent performs another important task. It carefully meters the amount of air to the gas burner. In a conventional furnace, far too much air is mixed with the gas resulting in less efficient operation. The Airco turbo vent controls the air/gas mixture precisely, for perfect combustion.

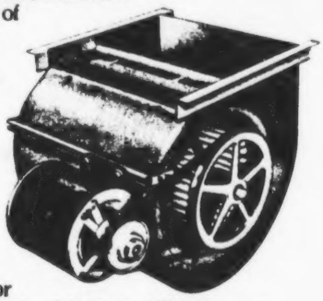


An Extra 65° C (150° F)

With a conventional gas furnace you'll find the stack temperature is normally around 230° C (450° F). With the 8300 turbo it's closer to 150° C (300° F). Yet the same amount of heat is being generated. This is a graphic demonstration of the greater efficiency of the 8300 turbo. Instead of allowing the heat to escape up the chimney the 8300 uses it to warm the air in your home. Less waste means lower fuel bills. Also, with the 8300 series many homeowners will be able to install a physically smaller furnace. This can save you valuable space in your home.



Adjustable Motor and Blower



No two homes are exactly alike when it comes to heating. The number of rooms, the size and shape of the house, location of furnace, length of ducts — many factors can influence heating efficiency and economy. Yet ordinary direct-drive blowers don't allow many adjustments, because the motor and blower are joined. With the 8300, however, the motor and blower are separate. So the air flow can be precisely adjusted to suit the home it's being fitted for. And tuned to deliver the most economical heat possible. Like all Aircos before it, the 8300 is quick to install, easy to service, and simple to maintain.

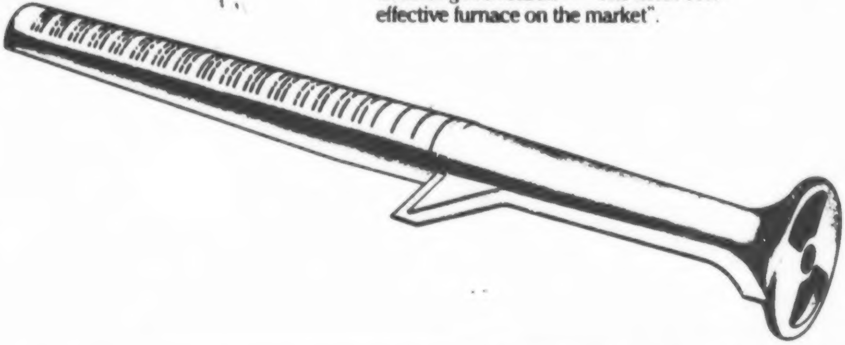
Airco's Balanced Burner

Most gas furnaces uses a very ordinary kind of burner. Usually, a straight piece of pipe of even diameter, with evenly spaced burner holes. Obviously, the pressure at one end is higher than the other. So, flame sizes vary. And that means "hot spots" on the heat exchanger. Airco's exclusive Burner is different. It's tapered. Has a contoured groove along its back. And sequentially spaced burner slots. The result is an evenly contoured flame along the entire length of the burner. That means balanced heat on all faces of the heat exchanger. And that means quicker, more efficient heat. Airco's exclusive burner design also gives a perfect air-fuel mix. So, you get a maximum amount of heat from a minimum amount of gas. And with today's rising fuel costs, that's a thought that should warm your heart for years to come.

Most dealers and servicemen recommend Airco to home owners because Airco Furnaces are:

- solidly constructed
- soundly designed
- top quality components
- easy to install
- easy to service
- immediate availability of spare parts

Designed and made in Western Canada for Canadian Winters. With the 8300 they have another good reason — "The most cost effective furnace on the market".



AIRCO ...Products for Home & Industry

Electronic Air Cleaner — Rid your home of foul air . . .

The average person breathes 16,000 quarts (18,000 litres) of air in a day. Yet this air is filled with visible and invisible particles which soil walls, carpets and other furnishings in your home. Normal home heating and cooling systems, cool, heat and recirculate the air throughout your home, but do nothing to remove airborne particles. To remove up to 95% of the dust, dirt, smoke, pollen and other impurities from the air you need an Electronic Air Cleaner, which not only provides a healthier breathing environment in your home but also reduces cleaning and on-going redecorating costs as well.

Central Air-Conditioning Unit or Heat Pump

With an Airco 8300, you can easily add the luxury of central air-conditioning to your home. (You use the same ducts and diffusers. The same blower to circulate the air. The same filter to clean the air.) It provides cool, refreshing comfort — right through the Summer. Makes sleeping easier, nights more enjoyable. And keeps your home cleaner, safer with the windows closed. The 8300 is an ideal unit to combine the other latest energy saving device — The add on Heat Pump. Ask your dealer for further details on this exciting money saving device.

Power Humidifier

Having a Power Humidifier in your home can help you breathe easier in more ways than one. In winter, it allows you to lower your thermostat setting while still maintaining the same comfort level. Every degree you lower the thermostat setting saves approximately 2% on your fuel bill. It also reduces static electricity. And stops furniture from cracking. In summer, the air seems easier to breathe. You feel fresher, think clearer. Houseplants thrive. Easy to install, a Power Humidifier pays for itself.

AIRCO PRODUCTS FOR HOME AND INDUSTRY

Furnaces	Airco Gas Furnaces Airco Oil Furnaces Electric Furnaces Solid Fuel Furnaces
Boilers	Gas Boilers Solid Fuel Boilers
Water Heaters	Gas Water Heaters Electric Water Heaters
Heaters	Wood Ranges Solid Fuel Ranges Solid Fuel Space Heaters Gas Unit Heaters
Comfort Control	Power Humidifiers Electronic Air Cleaners Commercial Electronic Air Cleaners Air Conditioners— "Split Systems" Heat Pumps
Controls	Room Thermostats Micro Electronic Thermostats Furnace Controls Zone Dampers
Accessories	Airco Diffusers Registers and Grilles Duct, Pipe, Elbows and Fittings Conversion Oil Burners and Parts Conversion Gas Burners and Parts Electric Motors and Controls Exhausters and Blowers Black Smoke Pipe and Fittings Class A Chimney; SS and Sentinel Class B Vent Vent Dampers

Your authorized Airco dealer

AIRCO

Products Distributed throughout Western Canada from
VICTORIA • VANCOUVER
EDMONTON • CALGARY

AIRCO PRODUCTS A division of Enheat Inc. Head Office: 1331 Clark Drive, Vancouver, B.C. V5L 3L1 Canada

NEW PRODUCT INFORMATION

SUBJECT: Lennox High Efficiency (Condensing) Pulse Furnace Model G14

The new Lennox Pulse combustion furnace was announced in the early fall of 1982 when the first prototype of the Canadian model came to B. C. With CGA approvals, distribution for sale commenced in about October 1982 and has been widely advertised and distributed by Lennox dealers throughout B. C.

This is the first warm air furnace using the pulse combustion process to be offered in Canada.

Furnace details are as follows.

Claimed Combustion Efficiency - 96 to 98% depending on model.

Claimed Annual Fuel Utilization Efficiency - 91 to 96%.

Shipping Weight - 250 to 300 lbs.

Heat Exchangers

Cast iron combustion chamber, coated steel exhaust tube and decoupler (heat exchanger/noise attenuator) section and fin tube stainless steel condensing section.

Flue Gas Temperature

As low as 100 to 120°F from the PVC (polyvinyl chloride) pipe used for venting.

Venting

The power venting combustion process exhausts flue gases through a 2" PVC pipe which is sloped ¼" to the foot so that any residual condensate returns to the furnace and hence to the drain tube. Combustion air is also provided directly to the burner through a 2" PVC pipe so that the furnace is not sensitive to negative pressures or contaminants within the home. Also, no large opening or duct through the wall is necessary to provide combustion air for the furnace, thus eliminating a possible source of cold drafts.

Condensate Drain

Plastic hose with a trap is used to take condensate to a floor drain, since the unit may produce 2½ gallons or more of condensate a day. Condensate pH ranges from 4 to 6.

Operation

A call for heat starts a pre-purge blower (34 seconds), then electronic ignition and gas valve operation. Combustion is sensed electronically and the ignition system and the blower are then shut down. Combustion is self-sustaining as a series of very small explosions and the negative pressure wave created as each pulse proceeds down the tail pipe causes more air/gas mixture to enter the combustion chamber on a repeating cycle at about 60 to 70 times per second. Each pulse produces about 0.25 to 0.5 Btu.

Installation

Because of the pulse combustion process involved, the manufacturer recommends some extra steps be taken during installation to ensure quieter operation of the system. This includes such items as vibration isolators under the furnace, flexible duct connectors and fibreglass lined ducts for both supply and return mains. Flexible coupling and vibration isolation should also be used on all gas and electrical connections as well as on the 2" PVC combustion air and exhaust stack. Special mufflers will be available soon for additional attenuation of noise from exhaust or air intake pipes. Routing the two 2" pipes up the inside of an unused brick chimney seems to work fairly well according to gas fitters who have used that method to achieve additional attenuation.

Cost

Approximately $2,800 to $3,500 to replace a furnace on existing ductwork.

Approvals

The Lennox model G14 is fully CGA approved in sizes from 40,000 to 80,000 Btu/hr input.

Availability

Readily available through all Lennox dealers in B. C.

December 1982: WGB
Energy Use Engineering Department

Energy Conservation Division
B. C. Hydro

JDS15.1

The amazing new

Lennox Pulse Furnace

[illegible] SAVINGS

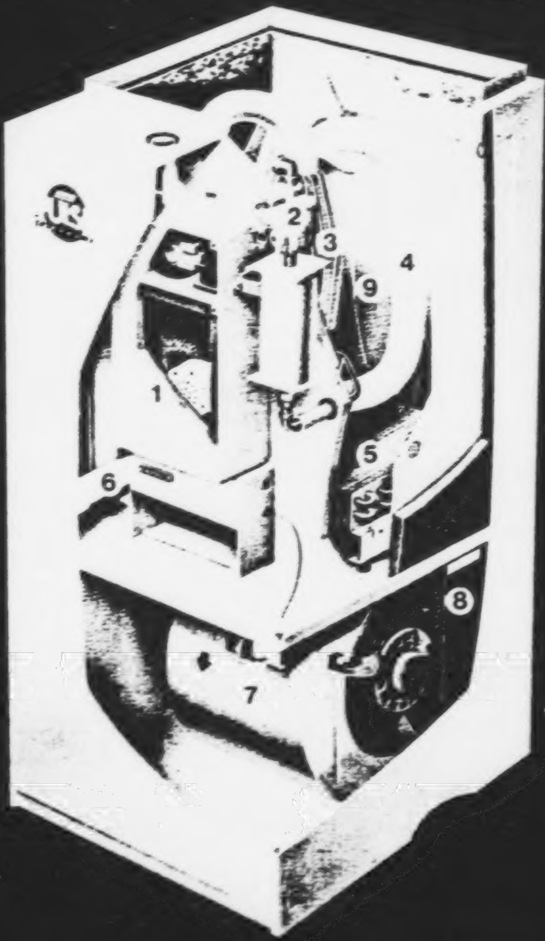
GUARANTEED!

Unprecedented heating efficiency

The Lennox Pulse gas furnace is the most significant breakthrough in furnace design in over 40 years. It produces heat unlike any other furnace with greater efficiency than ever before possible. Operating on a principle of pulse combustion, small quantities of gas and air are ignited by a spark plug. After the initial spark, combustion feeds on itself, providing unprecedented heating efficiency.

More heat, less waste

If your present gas furnace is over five years old, it is probably in the 55 to 60% efficiency range. Compare this with the Pulse efficiency ratings of 96 to 98%!* This difference can mean a drastic reduction in your monthly heating bills – enough to justify replacing your current unit today, though it still operates. The Pulse furnace is that efficient. Even if your system is a newer "high efficiency" model, your saving are still huge with the Lennox Pulse furnace.



1. Air intake, mixing valve and blower assembly 2. Gas valve 3. Combustion chamber 4. Tail pipe 5. Heat coil 6. Flue vent pipe 7. Blower 8. Filter 9. Exhaust decoupler

Extensive research and development

This amazing efficiency is the result of over five years of field testing and research. Lennox technology has made the Pulse furnace easy to install and service. (It can replace any Lennox up-flow furnace installed in the last 40 years with virtually no alterations in duct, cooling coil or accessories.) For LPG fired models, a conversion kit is required for changeover from natural gas.

Lennox add-on air conditioning coil, electronic air cleaner and power humidifier can easily be added to the furnace for a year-round Total Comfort system.

The Lennox Pulse furnace has a lot more going for it — low cost installation, high quality components, easy serviceability and quiet trouble-free operation. This outstanding design is backed by the Lennox reputation for quality, unequalled in over 87 years as an industry leader and innovator.

If converting from oil, installing a Pulse could be worth **$800 in C.O.S.P. grants.**

Efficiencies certified and approved by Canadian Gas Association

Heating Air Conditioning

The most efficient gas furnace on the market!

Reliable performance, low cost installation

Easy, low cost installation makes the Pulse an ideal replacement for your old system. It can replace most furnaces built within the last 40 years with virtually no major alterations in ductwork. It even eliminates the need for a chimney in new constructions, since flue products are vented with 2" plastic (PVC) pipe, vertically or through a wall. Outdoor air for combustion can also be piped to the furnace with PVC pipe. The condensate produced by the heat exchanger is non-corrosive to plastic, tile, cast sewer pipes or a septic tank and can be easily routed to any standard drain.

The heart of the system is the revolutionary pulse combustion heat exchanger. It's designed for long service life and carries a **20 year warranty**.

The heating process begins as air and gas are introduced into the combustion chamber to mix near the igniter.

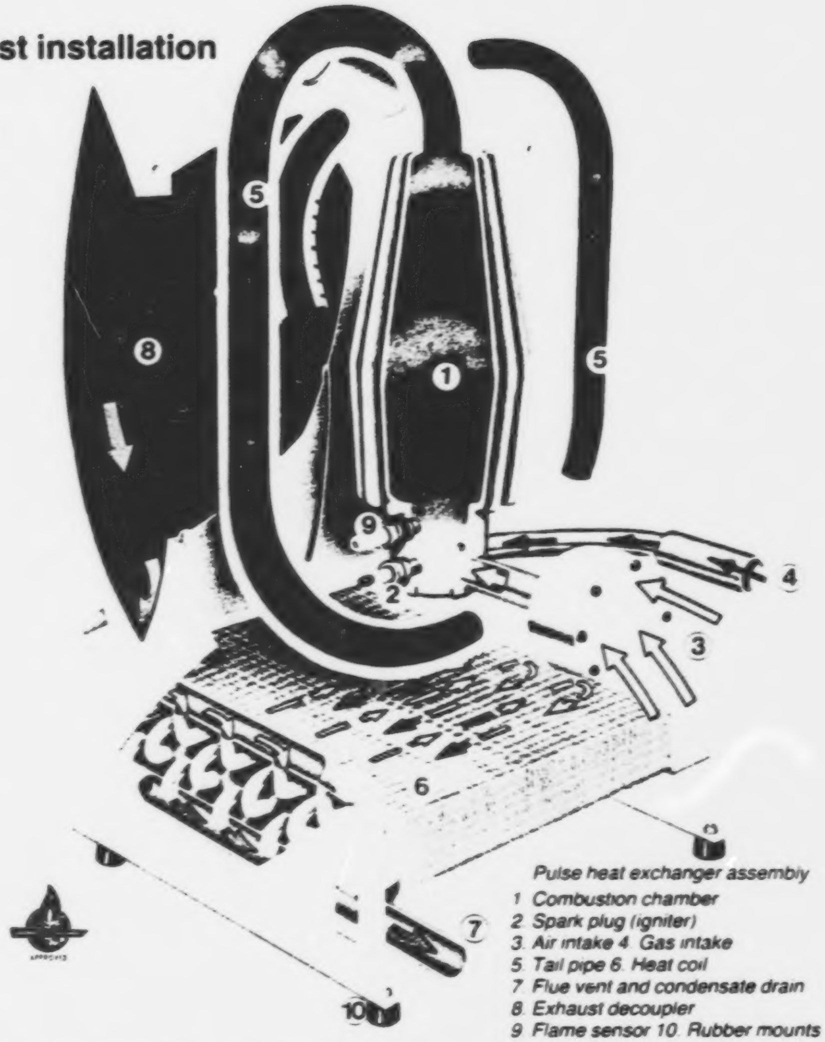
A spark creates the initial combustion, which in turn causes a positive pressure buildup that closes off the air and gas inlets. This pressure then forces the products of combustion down a tail pipe.

As the combustion chamber empties, its pressure becomes negative, drawing in air and gas for the next ignition.

At the same instant, part of the pressure pulse is reflected back from the end of the tail pipe.

It re-enters the combustion chamber, causing the new gas air mixture in the chamber to ignite and continue the cycle.

The Pulse will automatically shut down operation long before combustion products can ever escape, to provide the safest, most reliable service possible.



Pulse heat exchanger assembly

1 Combustion chamber
2 Spark plug (igniter)
3 Air intake 4 Gas intake
5 Tail pipe 6 Heat coil
7 Flue vent and condensate drain
8 Exhaust decoupler
9 Flame sensor 10 Rubber mounts

How much energy can the Pulse furnace save?
Plenty. This chart demonstrates the superior efficiency of the Lennox Pulse over conventional models. As you can see, the reduction in gas consumption is significant, no matter with which model you compare the Pulse. In a typical Canadian climate (2500 operating hours), the Pulse can pay for itself in just a few heating seasons when it replaces a low efficiency, standing, pilot furnace.

Furnace	Efficiency	Savings with the pulse over conventional furnaces
Pulse combustion	98%*	–
Lennox spark ignition furnace with vent damper (Conservator G8Q3E)	78%	20%
Lennox spark ignition furnace (G8Q3)	69%	30%
Lennox standing pilot furnace (G8Q3)	65%	34%
Industry lowest efficiency standing pilot furnace	55%	44%

**Efficiencies certified and approved by Canadian Gas Association* ***Availability to be announced*

LENNOX The energy/money savers

Heating Air Conditioning
400 Norris Glen Road Etobicoke, Ontario M9C 1H5
Vancouver Calgary Edmonton Winnipeg
Toronto Ottawa Montreal Quebec City Dartmouth

P 2003

NEW PRODUCT INFORMATION

SUBJECT: Pulse Combustion Boiler by Hydro-Therm Inc.

The development and arrival into the marketplace of the "Hydropulse" boiler has aroused curiosity and interest in the manufacturer's claims of relatively high seasonal efficiencies of 90% with fuel cost savings of up to 30%.

Ratings: Two sizes are available, having rated inputs of 50,000 and 100,000 Btu.h each, for firing with natural or propane gas. These can be used in the modular mode to meet higher heating loads.

Cost: List prices have been quoted at $2,100.00 and $2,500.00 respectively for the smaller and larger units, which is about 50% higher than conventional units. At claimed efficiencies, their payback period could extend to five or six years. The units are warranted for twenty years.

CGA Approval: Until final approvals are given by the Canadian Gas Association, field installations will be certified by the CGA at Hydro-Therm's expense.

Operation: The sequence of operation is well caricatured and simply explained in the attached manufacturers literature.

Location: A flue vent or chimney is not required, although the chimney can be utilized. This gives considerable flexibility of location, as small diameter plastic piping is used for induced combustion air from outside, flue gas exhaust and condensate drainage. Both models are 14 inch diameter, the A50 is 34½ inches tall and is suitable for under-the-counter apartment installations, the A100 is 48 inches tall and can be located in a suitable closet.

Condensate: Regulations governing the disposal of condensate to drainage are not yet standardized in all municipalities, prior approval may be required.

Versatility: Although originally designed for hydronic heating systems, with minor modifications and the use of heat exchanger coils, it can be combined with forced warm air systems and similarly applied for domestic or service hot water supply.

Efficiency: Where fuel burning is concerned, efficiency and economy are symonymous. Contributing to its efficiency is the releasing of the latent heat of vapourization from the

JDS9.3

condensation of the water vapour in the hot flue gas from the products of combustion and claimed as about 9% of the fuel input.

Spark plug ignition eliminates the need for a pilot light.

Combustion air is drawn in from outdoors into the sealed combustion chamber and thus does not add to the infiltration rate or the heat loss of the building.

The principle of pulse combustion is not new. Earlier models produced in the 1950's were high priced and had a slight noise problem during operation. They received limited acceptance during a period of plentiful and inexpensive fuel. Increased fuel costs together with refinements and improvement in lowering the noise to acceptable levels, have now resulted in a viable product.

Further specifications and details are contained in the attached copy of the manufacturer's literature.

A new data sheet, G 2105, will be issued containing further technical details, including information about other innovative energy efficient gas fired heating units.

Preliminary advance data for internal information only.

June 1982: WJD
Energy Use Engineering Department

Energy Conservation Division
B. C. Hydro

JDS9.3

Innovators in energy conservation.™

HYDROTHERM INC

ROCKLAND AVE.
NORTHVALE, N.J. 07647
(201) 768-5500/TELEX 13-5357

10 MARYLAND AVE.
DUNDALK, MARYLAND 21222
(301) 285-2300

6880 REXWOOD ROAD
MISSISSAUGA, ONT. L4V 1L8 CANADA
(416) 678-9215/TELEX 06-968693

RATINGS

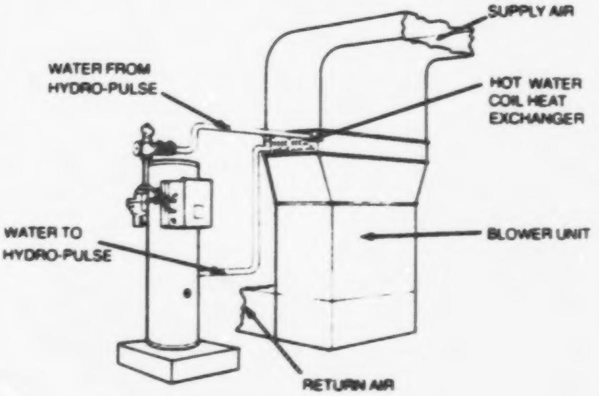
30 psi ASME Working Pressure

Model	Natural Gas				Propane Gas				Approx. Shipping Wt. (LBS)
	AGA Input MBH	Mfrs. Output Rating			AGA Input MBH	Mfrs. Output Rating			
		Gross MBH	Net (1)MBH	EDR (2)		Gross MBH	Net (1)MBH	EDR (2)	
A-50	50	45.7	39.7	264	48	43.8	38.1	254	240
A-100	100	91.4	79.5	530	90	82.2	71.5	477	332

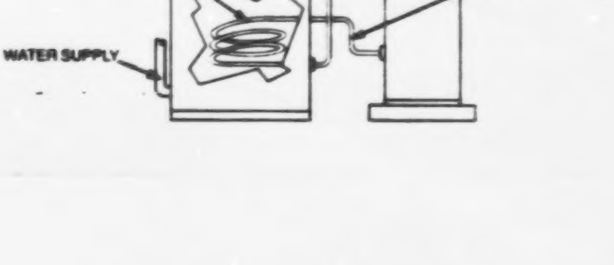
(1) Boiler ratings are manufacturer ratings, based on steady state efficiency of 91.4%, allowance of 1.15.

(2) Based on 150 BtuH per sq. ft. EDR @ 170F. average water temperature. NOTE: For operation at altitudes above 2,000 feet above sea level, boiler input and ratings must be reduced 4% for each 1,000 feet above sea level.

WARM-AIR APPLICATIONS: Combining the Hydro-Pulse boiler with a hot water heat exchanger coil in a forced-air ducted system provides the most fuel efficient hydronic/warm air heating system available. On retrofit applications, furnace burners are turned off and only the blower is required. Coil is installed in the furnace plenum (or close-coupled to a separate blower unit). The hot water coil transfers boiler's full heat output to air passing over the coil. Design criteria for a typical residential system (A-100 Hydro-Pulse/C-100 Coil) features 70F inlet air and 135F outlet air temperature with .15" W.C. pressure drop...and 165F entering and 125F leaving water temperature with 3' W.C. pressure drop.



HOT WATER HEATING APPLICATIONS The Hydro-Pulse boiler handles domestic or commercial volume hot water heating requirements, with or without separate zones utilizing external or internal heat exchanger coils in conjunction with water storage tanks. Hydro-Pulse boiler circulates heated boiler water through the heat exchanger coil which transfers heat to the service water. No flue. No stack. No extra burner-tank required. The design criteria for a typical single tank domestic water system (A-100 Hydro-Pulse/65-gallon storage tank) features 108 gallon-per-hour recovery rate using a 20-square foot internal coil heating surface. Based on 40F/140F service water. Boiler water will not exceed 200F.

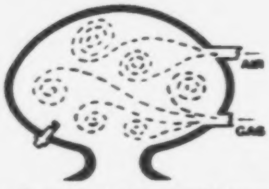


"HYDRO-PULSE"

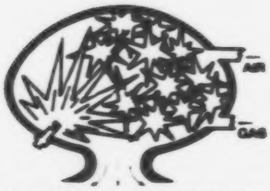
Gas Fired Hydronic Direct Vent
Pulse Combustion Boiler

Operation

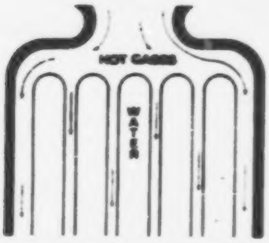
HYDRO-PULSE The Hydro-Pulse boiler by Hydrotherm is a design of many energy saving features. It's the result of many years of extensive testing and development in Hydrotherm research and development laboratories to produce a boiler using the high efficiency sealed, pulse combustion principle. Pulse combustion is nothing more than a steady series of controlled mini-explosions, one after the other, that release heat.



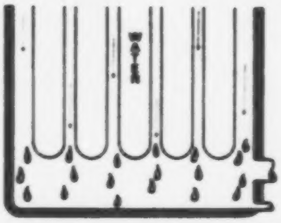
1 To start the boiler a small blower forces outside air into a sealed chamber where it is mixed with gas



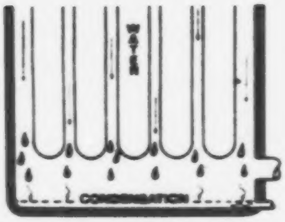
2 A spark plug is used on the first cycle only to ignite the mixture



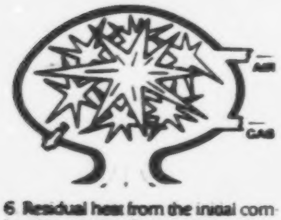
3 The pressure resulting from the combustion process forces the hot gases through tubes in the heat exchanger where surrounding water absorbs the heat



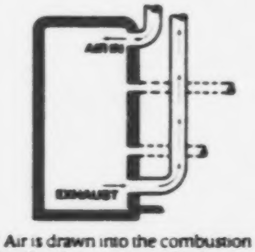
4 As the hot gases are cooled below the dew point condensation of the water vapor in the flue gases takes place releasing the latent heat of vaporization amounting to about 9% of the fuel input



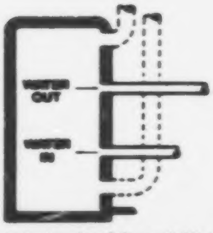
5 Condensation collects in the base of the boiler and is removed by a condensate drain



6 Residual heat from the initial combustion ignites the second and subsequent air/gas mixtures without the need for the spark plug or blower at a rate in excess of 60 cycles per second.



7 Air is drawn into the combustion chamber from outdoors by the vacuum caused by the velocity of the exiting exhaust gases both through small diameter plastic pipe No flue or chimney is needed



8 Water is circulated through Hydro-Pulse ™ in much the same manner as in a conventional boiler

NEW PRODUCT INFORMATION

SUBJECT: Kool-Fire Heat Pumps

1. DESCRIPTION

These units could be described as gas assisted split system heat pumps. Their outdoor units consist of a compressor, heat exchanger ("A"-coil), air handler and a gas burner below the heat exchanger. The indoor section consists of a heat exchanger and an air handler.

The system operates as a split system central air conditioner in summer. In winter, it cycles as an ordinary split system heat pump down to about +5°C.

At lower temperatures, the outdoor fan stops and the gas burner starts; the compressor continues to run. The heat pump, instead of removing heat from outdoor air, removes heat from the gas combustion products, cooling them to approximately 8-10°C.

When the outdoor ambient temperature rises to approximately 8°C, the unit switches back to the standard heat pump mode.

2. EFFICIENCY

When in the gas burning mode, efficiency is claimed to be approximately 98%. In the heat pump mode, the COP is claimed to be 2.08 at +2°C.

3. BENEFITS

The Kool-Fire unit should be able to provide heating and cooling at a low annual energy cost. It utilizes the advantages of the air source heat pump in mild weather and uses relatively low cost gas energy in cold weather.

Since no electric resistance heat is required, a 100 amp residential service will be adequate in many cases.

There is no defrost cycle, thus eliminating the inefficiencies introduced by reverse cycle defrost requirements.

The complete unit is put together from "off-the-shelf" components. The manufacturer claims that nothing is "made to order". Thus, replacement parts are readily obtainable.

The compressor and outdoor coil are guaranteed for five years. Other components are guaranteed for one year.

No chimney or vent pipe is required.

These units qualify for the $800 COSP grant for conversion of oil heating systems.

4. COSTS

A conversion using an existing furnace blower and ductwork will cost around $3800-$4500 on average. A new home installation will run $6000-$7000 or more, depending on size and design.

5. APPROVALS

Kool-Fire units are CGA, CSA and AGA approved.

6. COMMENTS

When considering total cost (including initial investment) it would be cheaper to provide heating using a gas furnace. However, where an owner wants central air conditioning, the Kool-Fire unit is worth considering.

EUE plans to monitor several suitable installations of this product in the near future.

7. AVAILABILITY

B. C. distributor is:

Astravan Distributors Ltd.
141 Riverside Drive
North Vancouver, B. C.
V7H 1T6

Phone: 929-5488
(Mr. Patrick H. Martin)

Preliminary advance data for internal information only.

June 1982: GP
Energy Use Engineering Department

Energy Conservation Division
B. C. Hydro

JDS9.10

Kool~Fire HOME COMFORT CONTROL SYSTEMS

98

The heat pump and condensing gas furnace designed to operate between –40°F and 115°F, economically

The traditional way to heat a home has always been to have a flame burning somewhere in the dwelling, be it an open fire in a cave, or a roaring gas fire in a furnace in the basement.

No matter what kind of fire it was, or where it was located, the fire always had to have a constant source of combustion air to keep it going.
In a modern home that constant source of combustion air is usually the air from within the house.

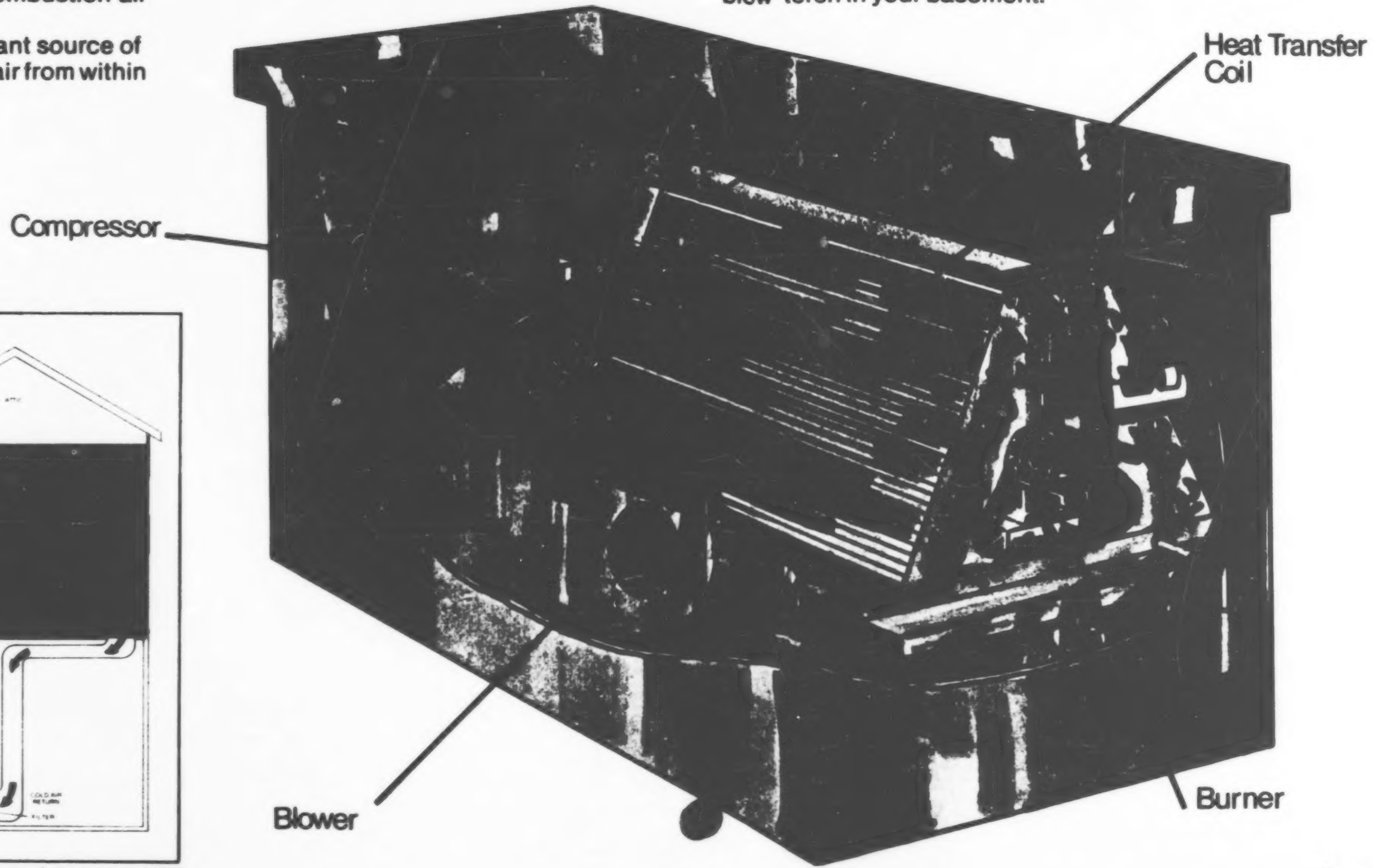
Air which you have already heated. Air, which in turn, has to be replaced by cold air from outside the house.
Replacement air usually comes in through open doors or windows, but it also comes through little cracks and crevices around improperly sealed doors, windows and even under the sill of the house.
Even when your furnace stops, heated air continues to flow up the hot chimney. And this air must also be replaced.
Kool-Fire has invented a new and infinitely more efficient way to heat your home or office. Kool-Fire is the successor to the blow torch in your basement.

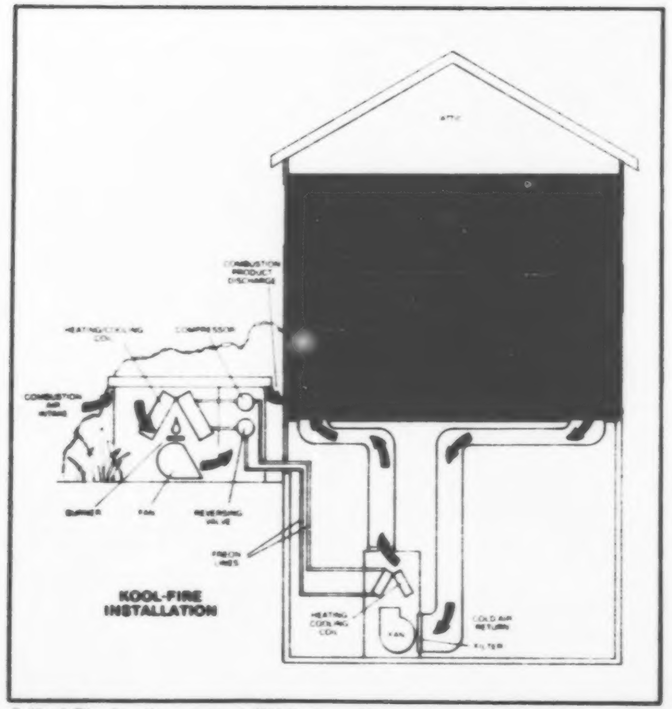
Because Kool-Fire places the combustion unit outside your home where it can burn using non-heated air so efficiently that it doesn't even need a stack.
When weather warms up, Kool-Fire 98, with the flip of a switch, becomes an Air Conditioner and continues to keep your home comfortable.

A CANADIAN DEVELOPMENT
MANUFACTURED IN CANADA AND UNITED STATES

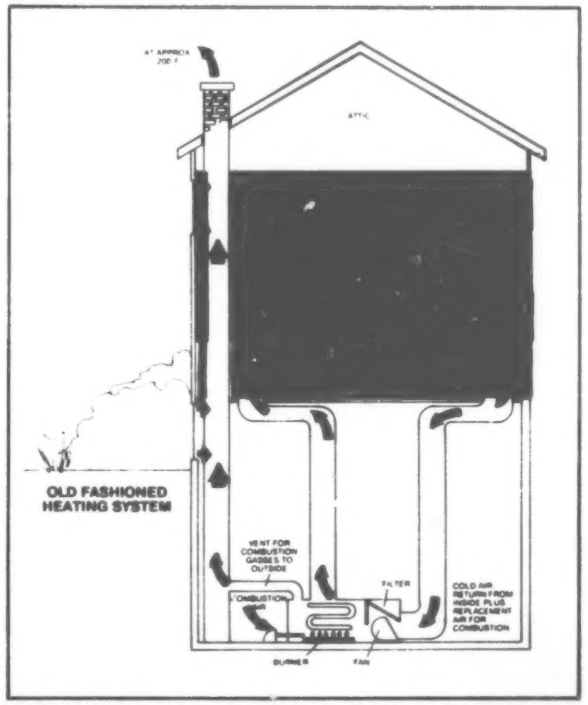
DESIGN COMPLIES WITH NATIONAL SAFETY STANDARDS
AMERICAN GAS ASSOCIATION
CERTIFIED

APPROVED


Heat Transfer Coil
Compressor
Blower
Burner


ATTIC
COMBUSTION PRODUCT DISCHARGE
HEATING/COOLING COIL
COMPRESSOR
COMBUSTION AIR INTAKE
BURNER
FAN
REVERSING VALVE
FREON LINES
KOOL-FIRE INSTALLATION
HEATING COOLING COIL
FAN
COLD AIR RETURN
FILTER

A Kool-Fire heating system distributes a large volume of air at approx. 105°F which prevents harsh contrasts in temperature and stratification within the room.


AT APPROX. 200°F
ATTIC
OLD FASHIONED HEATING SYSTEM
VENT FOR COMBUSTION GASSES TO OUTSIDE
COMBUSTION AIR
FILTER
COLD AIR RETURN FROM INSIDE PLUS REPLACEMENT AIR FOR COMBUSTION
BURNER
FAN

The usual gas or oil fired hot air heating system distributes air at 130°F which stratifies in definite layers and also causes you to feel hot when the furnace is on and cool between heating cycles.

Technical Information

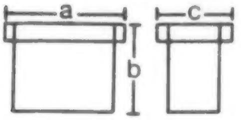
***Operating Modes**
- Heat Pump
- Air Conditioner
- Condensing Gas Furnace
- No defrosting cycles are required

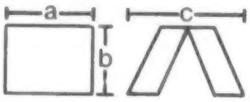
*The most efficient operating mode is automatically selected.

Mechanical Specifications

Dimensions of Units

	a	b	c
Exterior Unit	52"	43"	26"
Interior Unit	24"	24"	22"





Weight of Units

Exterior Unit - 300 lbs. (136 kg.)
Interior Unit - 91 lbs. (41 kg.)

Maximum allowable distance between units - 60 Ft. (18.28 m)

Unit Sections connected by
1 Electrical line ¾" O.D. (1.90 cm)
and 1 (one) ⅝" (1.59 cm) O.D. pipe
and 1 (one) ⅜ (.95 cm) O.D. pipe

Minimum size of opening required for connecting pipes - 4" O.D. (10.16 cm).

Size of Chimney required - Nil

Volume of Inside Combustion Air Consumed - Nil

Weather Protection Required for Exterior Section
Snow - Nil
Rain - Nil

Range of Outside Temperatures for Efficient Operation - − 40° Celsius (−40° F) to 46° Celcius (115° F)

Energy Requirements
- 230 − 115 VAC. for operating compressor and fan motors (Does not require 200 Amp. service)
- Natural Gas for heating or
- Propane Gas for heating

Installation
- The heating and cooling compressor, heating and cooling coil, combustion unit and controls are installed in a galvanized steel container outside the home.
- A heating and cooling coil, filter, circulation fan and thermostat are installed inside the home using — a. some of your existing equipment,
  — b. a new enclosure in your home
- a 4 in. square opening is required for the connecting piping between the exterior and interior unit
- existing duct work is used

Maintenance
- all parts and components are readily available from off the shelf supplies and are designed for quick and easy maintenance by service men.

Kool-Fire Units are approved for use in every Province and Territory in Canada and Certified by the Canadian Gas Association, and Certified by the American Gas Association for United States.

Note: Patents are Pending in Canada, U.S.A. and other Countries. Kool-Fire Trademark is Registered. Because of our ongoing policy of research and development, we reserve the right to make changes in specifications without notice.

Guaranteed 98% Efficient

As Per Independent Laboratory Test

Gerry Vandervaart, President

Robert F. Keighan

Robert F. Keighan, Vice-President

DISTRIBUTED BY:

Astravan Distributors Ltd.
141 RIVERSIDE DRIVE
NORTH VANCOUVER, B.C.
929-5468 V7H 1T6

APPENDIX C

SPECIAL CONSIDERATIONS AND COMMENTS

CLARE

SPECIAL CONSIDERATIONS

At the request of the Provincial Gas Inspector in November 1981, a tour was made of several high efficiency installations. One of the Clare furnaces was acting suspiciously and was therefore checked by the gas inspector who checked for CO. His instrument went off scale at 500 ppm. The next work day this furnace was torn down by our Metro Gas personnel to find the problem. A Provincial Gas Inspector was present. CO was measured at 3,000 ppm. The Provincial Gas Inspector filed an Appliance Field Observation Report to CGA and a copy was sent to Clare. About one month later, five of the Clare executives from the factory and sales division were in Vancouver and personally inspected two installations and promised field changes.

The Clare people were familiar with the problem as it had evidently occurred before.

COMMENTS

In early 1983, after personal contact with a member of CGRI some documentation was received which indicated that some changes had been made to the current models of this furnace. Corrosion problems continued to deteriorate the original test installations and some doubt remains as to the long-term durability of the units installed. Frequent checking and minor repair work continues.

We wrote to Clare in March 1983 to seek a permanent solution to the problems. Subsequent to our letter to Clare, one unit corroded to the point that it must be replaced. See section on "corrosion" in this appendix. Clare responded in May 1983, outlining briefly a number of changes made to their newer models. They also supplied one of the new models as a replacement for the unit which failed. This has now been installed.

ICG

SPECIAL CONSIDERATIONS

The three ICG furnaces supplied for the test by the manufacturer were supplied on the understanding that they were prototype units and that some changes might be made in the version marketed to the public. In fact, a number of problems did occur with these units and substantial amounts of time were spent troubleshooting and replacing parts. The manufacturer was helpful in this regard and it is hoped that the units sold to the public will be much less troublesome.

Some of the problems which occurred were:

- a pinhole leak in a tertiary heat exchanger;
- mismatch of controls with existing thermostats. This was resolved as outlined in the "controls" section of the discussion;
- problems with spark ignition modules;
- corrosion of balancing tabs on induced draft fans.

COMMENTS

All the problems that occurred with these units have been resolved with the exception of the corrosion of the balancing tabs on the induced draft fans. Presumably, the manufacturer will be using corrosion resistant materials for these tabs on newer equipment.

AMANA

SPECIAL CONSIDERATIONS

The basic outdoor heating section has been used in Amana equipment for about twelve years and the manufacturer reports that no problems have been encountered with this section.

The water heater section has only been available for about one year. It requires a three-way valve installed in the inside air handler and when used with a single wall heat exchanger in the water heater, required a change from ethylene glycol to non-toxic propylene glycol. The addition of the water heater and the use of a heat exchanger to heat potable water, raised many questions with the plumbing inspector and the city water supply authorities. Also, some difficulties were encountered with the use of the propylene glycol. Thick floculent brown clouds formed in the reservoir tank and laboratory analysis indicated these to be chelates of iron and copper. We also found we could not get propylene glycol with proper inhibiters for corrosion control without adding substances listed as "toxic" thus defeating the purpose of using a non-toxic type glycol.

COMMENTS

At our suggestion, Amana units now sold in B. C. are provided with double wall finned tube heat exchangers for all water heaters, permitting the use of ethylene glycol. This solves two problems:

- ethylene glycol with good inhibitors can now be used and we don't get strange "growths" in the expansion tank;
- this resolves the question raised by the city water works and the plumbing inspectors without expensive models of back flow preventers and other equipment, which would add several hundred dollars to the cost of an installation. These additions would have been necessary to prevent a foreign material from entering a water main should the main pressure fall below the system pressure and a hole developed in the former single-walled heat exchanger tubing simultaneously.

The only unresolved question at this time is the noise in one of the replacement three-way valves.

In general, the system performs well and the domestic water heater is rated excellent by all homeowners.

Several lessons were learned in the installation of these four systems.

1. Foam "rubber" one piece pipe insulation was used on all lines between the indoor and outdoor sections. It is wise to check the system for leaks - with the system fired up - before insulation of any solder joints, although long sections of pipe between joints are best pre-insulated.

2. Thermometer wells were installed on the low points of the system on supply and return lines, both inside and outside. These proved to be invaluable for system maintenance, since they permitted the draining of only the part of the system being worked on when changing three-way valves, resoldering any leaks, etc. We recommend the installation of drain points at these locations and the use of "silver solder" at these threaded elbows.

   We also recommend the installation of sufficient isolation valves to permit water heater or "furnace" servicing without draining the entire system.

   The outdoor unit should be installed at least five feet away from the gas meter. It should also not be below or near any window or door nor close to any siding that steam could condense on since this could be objectionable. (Install outdoor unit at least 3 feet from house and 10 feet from doors or operable windows).

ARKLA

SPECIAL CONSIDERATIONS

In the two units received, the wiring diagram did not match the wiring found in the furnace. One of the furnaces was rewired to match the diagram.

In both installations, large clouds of fog from the vent were diverted back onto the siding of the home, condensing on siding and windows on that side of the house and raising questions about moisture entering the attic through the soffit vents above. Both vent systems have been altered to alleviate this problem. See the "venting" section of this appendix. Both Arkla units were installed retaining existing thermostats and both experienced operating problems (short cycling and "droop") due to overanticipation in the thermostat. The problem was solved by interposing a relay as outlined under the "controls" section in the discussion.

COMMENTS

The furnace, in general, appears to be well designed and is quiet in operation. Venting requires careful consideration and we recommend that venting the unit through the roof be considered.

The percentage of flue gas moisture condensed appears to be less than from other condensing furnaces, which is why larger quantities of "fog" is produced from the vent.

Initial measurements over two weeks, indicate vapour condensed is less than 2% of that present, therefore its efficiency could be expected to be slightly less than some other condensing furnaces. However, the results, to date, have not indicated this.

AIRCO

SPECIAL CONSIDERATIONS

Since we have not been directly involved with the installation of these units, we have no first-hand knowledge of installation or operating problems. It has been reported that a problem involving leakage at the connection to the induced draft fan has occurred and that the manufacturer has corrected this on their new models.

The unit is in a conventional sized cabinet and can be co-vented with the water heater, however, the vertical "B" vent must be sized from the "B" vent tables in the gas code based on furnace/water heater inputs.

Because of the low flue gas temperature it would be wise not to vent this furnace into an outside masonry chimney, unless a liner is installed to handle any condensation that may occur in the chimney. This precaution should not be necessary for chimneys not exposed to outside wall temperatures.

COMMENTS

Initial market penetration of the intermediate efficiency series 8300 furnace appears to have been good, possibly due to the relatively modest cost premium for these units as compared to conventional furnaces. The initial success of the unit is leading the manufacturer to pursue expanding the line to produce one or two smaller models, including counter flow units.

LENNOX G14 PULSE FURNACE

SPECIAL CONSIDERATIONS

Since we were not directly involved with either of the two installations we are monitoring, except to supply additional metering, we have no first-hand knowledge of any installation or operating problems. We are aware of two minor assembly or component problems, but we understand that these were quickly rectified by the manufacturer.

COMMENTS

We have inspected two units which we considered to be too noisy for many residential applications. A third and later installation was inspected and had a noise level that we considered to be acceptable in most situations.

HYDRO PULSE BOILER

SPECIAL CONSIDERATIONS

We have no installations under detailed monitoring and therefore cannot report first-hand on special considerations for installation. One customer (not part of our test program) reported that his was one of the very first installations and was removed due to noise problems (over one year ago) - no mufflers were available at that time. Mufflers are now available.

COMMENTS

The Pulse burner on these units will not operate at low gas pressures of about 5" WC or less and the unit incorporates no inches-to-inches gas pressure regulator. In a couple of cases, when connected to low pressure gas mains, burners shut down due to low pressure. Inches-to-inches gas pressure regulators had to be installed to overcome this problem.

Special care must be exercised when installing any pulse combustion system so that pulse noise does not intrude on a neighbours peace and quiet. It appears that venting the unit through the roof, preferably through the centre of a brick chimney, is a preferred method and provides acceptable attenuation of pulse noise.

KOOL-FIRE HEAT PUMP

SPECIAL CONSIDERATIONS

B. C. Hydro was not involved in the installation of these units and therefore has no first-hand knowledge of installation and operating problems.

The distributor reports that minor problems may occur when traditional air conditioning installers install their first unit, since they assume head pressures, gas charging, etc. are identical - which they are not. To date, no operating field problems have been reported.

COMMENTS

Ontario Hydro has completed some performance tests on a Kool-Fire unit and found an average efficiency of 94% in the condensing gas furnace mode but somewhat disappointing performance in the heat pump mode. Ontario Hydro is currently carrying out research for the Canadian Electrical Association on the optimization of this equipment.

POOR

QUALITY

ORIGINAL